DRAFT

ENVIRON WMS
Water Management Services

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

Remedial Investigation/Feasibility Study
Eagle Zinc Company Site
Hillsboro, Illinois

Submitted To

U.S. Environmental Protection Agency
and
Illinois Environmental Protection Agency

Submitted By

EnvironWMS
740 Waukegan Road, Suite 401
Deerfield, Illinois

On behalf of
Eagle Zinc Parties

March 2004

ENVIRON

March 17, 2004

Mr. Dion Novak
Superfund Division
United State Environmental Protection Agency
77 West Jackson Boulevard
Mail Code: SR-6J
Chicago, Illinois 60604

Re: Draft Screening Level Ecological Risk Assessment
Remedial Investigation/Feasibility Study
Eagle Zinc Company Site, Hillsboro, Illinois

Dear Mr. Novak:

Enclosed please find the draft report entitled *Screening Level Ecological Risk Assessment* for the Eagle Zinc Company Site. This report fully addresses all comments received from USEPA to date concerning the screening level ecological risk assessment.

If you have any questions concerning this submission, please do not hesitate to contact us.

Sincerely,

ENVIRON International Corporation

F. Ross Jones

F. Ross Jones, P.G.
Manager

FRJ:alb
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Attachment

cc: Thomas Krueger, Esq. – USEPA Region 5
Rick Lanham – IEPA Bureau of Land
Chris English – CH2M Hill
John Ix, Esq. – Dechert
Paul Harper – Eagle-Picher
Gordon Kuntz – Sherwin-Williams
Roy Ball – ENVIRON
Janet Kester – ENVIRON
Wendy Larson – Limno-Tech

Screening Level Ecological Risk Assessment for the Eagle Zinc Company Site

Prepared by:

EnvironWMS

March 2004

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1.0 EXECUTIVE SUMMARY

This report describes the results of a screening level ecological risk assessment (SLERA) for the Eagle Zinc Company site ("the Site"), located in the Township of Hillsboro, central Montgomery County, Illinois. The Site was initially listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) on June 1, 1981. A remedial investigation/feasibility study (RI/FS) is being performed for the Site in accordance with the December 31, 2001 Administrative Order on Consent between the Eagle Zinc Site Parties ("the Parties") and the United States Environmental Protection Agency (EPA). As stated in the RI/FS Work Plan (ENVIRON 2002b), the primary focus of the RI is to characterize the nature and extent of releases at the site, to assess potential migration pathways by which the Site-related chemicals could impact humans or valued ecological receptors, and to evaluate potential risks to those receptors. On behalf of the Parties, EnvironWMS has conducted this SLERA to evaluate whether valuable wildlife resources (receptors of concern [ROCs]) may be adversely impacted by exposure to Site-related chemicals of potential ecological concern (COPECs).

The Site occupies approximately 132 acres in a mixed commercial/industrial and residential area to the east of Hillsboro. Twenty-three buildings cover 10% to 15% of the Site. Other Site features include railroad spurs, residual material stockpiles, several paved and unpaved roadways, a stormwater retention pond located in the southwestern corner of the Site, a pair of engineered stormwater retention ponds located near the eastern property boundary, and a small pond located between two railroad spurs near the entrance to the plant. The Site was in continuous industrial use for 90 years (from 1912 until 2002); operations included zinc smelting, manufacture of sulfuric acid, manufacture of zinc oxide, and manufacturing of leaded zinc oxide. The northern portion of the Site was historically used for agricultural production, which ceased in the 1980s.

The Site property is zoned for commercial/industrial use, and local officials have indicated to EnvironWMS that there are no plans to re-zone the property for other uses. According to the Mayor of Hillsboro, Hon. William Baran, and the Chairperson of the Planning Committee, Thomas L. Gooding, once the Site is ready for reuse the City plans to incorporate the Site into the City limits, to obtain ownership of the property, and to redevelop it for commercial/industrial use. This is consistent with the plans of the owner of the Site.

This SLERA is based on the understanding that future land use at the Site will remain commercial/industrial, and is intended to provide input to risk management decision-making for the Site while maintaining a conservative approach that is protective of sustainable wildlife populations, communities, and ecosystems. The Parties are willing to develop appropriate institutional controls, and view a Ready for Reuse Determination (EPA 2004) for the Site as a key component in its development for productive commercial/industrial reuse. The general methods used in the SLERA follow EPA's eight-step guidelines for conducting ecological risk assessments at Superfund Sites (ERAGS; EPA 1997a) and other applicable EPA guidance (EPA 1997b, 2001a&b, 2003). Based on this framework, an ecological risk assessment consists of four primary components: (1) Problem Formulation; (2) Exposure Characterization; (3) Effects Characterization; and (4) Risk Characterization. This SLERA comprises Steps 1 and 2 of the ERAGS process.

As part of problem formulation, Site reconnaissance visits were conducted on July 15, 2002 and March 3, 2004 to (1) assess the nature and quality of terrestrial and aquatic resources on and in the vicinity of the Site; (2) identify habitat types and their extent; (3) identify species actually or potentially present on and in the vicinity of the Site; (4) identify COPECs and their potential migration pathways resulting in exposure of ecological receptors; (5) assess the potential for non-chemical stresses on and in the vicinity of the Site; and (6) document obvious environmental impacts and their likely causes. These Site visits provided evidence that the intensive industrial activities conducted at the Site over the past 90 years have caused marked physical disruption on and, to a lesser extent, in the vicinity of the Site, with resultant destruction and degradation of habitat and adverse ecological effects. The following observations are relevant to evaluation of the Site with regard to potential ecological risk:

- Habitat types and quality in the vicinity of the Site are unremarkable and similar to that observed at the Site – no "sensitive habitats" as defined in EPA guidance (1997a) were observed (or would be expected) on or in the vicinity of the Site;
- No threatened or endangered species were observed, and none are expected within a mile of the Site boundaries, according to the Illinois Natural Heritage Database;
- Widespread physical disturbance and resultant habitat degradation is evident on-Site; and
- The off-Site Eastern and, in particular, Western Drainage Areas also exhibit impacts associated with the Site and other nearby commercial/industrial operations, but provide some aquatic and wildlife habitat for common regional species that were observed during the Site visits.

In accordance with ERAGS (EPA 1997a), in the absence of threatened and endangered species and sensitive habitats, an ecological risk assessment should evaluate potential risks at the level of sustainable wildlife populations, communities, and ecosystems. Due to the marked physical disruption and resultant degradation of habitat on-Site, it does not support wildlife populations, communities, and ecosystems. In addition, because of ongoing disruption necessary for redevelopment, the Site is unlikely in the future to offer the type and size of undisturbed habitat necessary for the sustenance of wildlife populations, communities, and ecosystems, despite the recently observed presence of a few representatives of unremarkable opportunistic species. Therefore, off-Site ecological receptors, including water- and sediment-dwelling organisms and species representative of piscivorous birds and mammals that may forage in the Western and Eastern Drainage Areas were identified as ROCs for this SLERA.

Potential risks to ROCs were assessed by calculating screening-level hazard quotients (HQs) as the ratio of maximum detected concentrations of COPECs in surface water and sediment to generic default ecotoxicity screening values for these media. As shown in Figure ES-1-1 and Figure ES-1-2, the HQs for zinc and cadmium were elevated for all receptors at the Western Drainage Area nearfield sampling location, but the lower HQs at the farfield location indicate attenuation with distance. At the Eastern Drainage Area nearfield location, the HQs for zinc and, to a lesser extent cadmium, were also elevated for all ROCs (Figure ES-1-3 and Figure ES-1-4). However, the HQs at the farfield location were not elevated, indicating marked attenuation with distance. Thus, the available data indicate that Site-related ecological impacts (if any) in the offsite Western and Eastern Drainage Areas are spatially limited.

The SLERA process culminates in a clearly defined scientific management decision point (SMDP). The SMDP represents a critical step in the Ecological Risk Assessment process where results are presented and multi-stakeholder risk management decision-making occurs. The results of this SLERA indicate that elevated HQs for selected ROCs in the nearfield Western and Eastern Drainage Areas are related to locally elevated levels of zinc and cadmium in surface water and sediment. Therefore, additional information may be necessary to determine what, if any, further evaluation of Off-Site surface water and sediment is warranted for protection of valuable ecological resources.

However, it is important to recognize that, in accordance with ERAGS (EPA 1997a), these HQs represent the absolute worst-case conditions in that they were calculated using maximum detected concentrations and minimum generic ecological screening levels, and do not take into account frequency of detection, spatial distribution, bioavailability of the COPECs, spatial and temporal variability in receptor exposure, or causality of effect between stressor and receptor. Because this approach necessarily overpredicts rather than underpredicts risks, the results should not be construed as indicating that further ecological risk assessment or remediation is required. Rather, interpretation of these HQs requires both understanding of the uncertainties and degree of conservatism inherent in the screening-level approach and consideration of the ecological context of the Site, including the magnitude of the HQs associated with COPEC concentrations at background locations, potential ROCs, and the nature, quality, and quantity of available habitat.

This report is organized according to the primary components of an SLERA, as defined by EPA (1997a):

2.0 Introduction

3.0 SLERA Approach

4.0 Screening-Level Problem Formulation

5.0 Screening-Level Ecological Effects Evaluation

6.0 Screening Level Exposure Estimates

7.0 Screening Level Risk Calculation

8.0 Scientific Management Decision Point

9.0 References

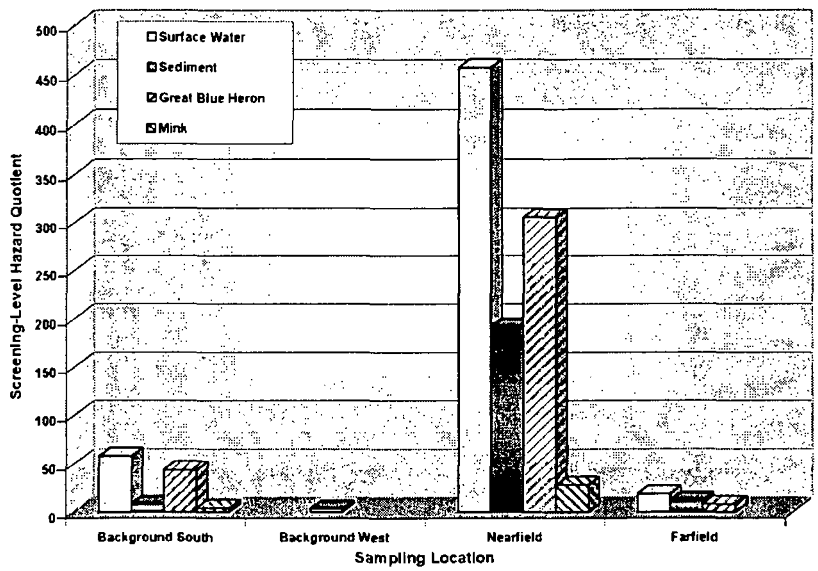

Figure ES-1-1. Hazard Quotients for Zinc in Surface Water and Sediment, Western Drainage Area

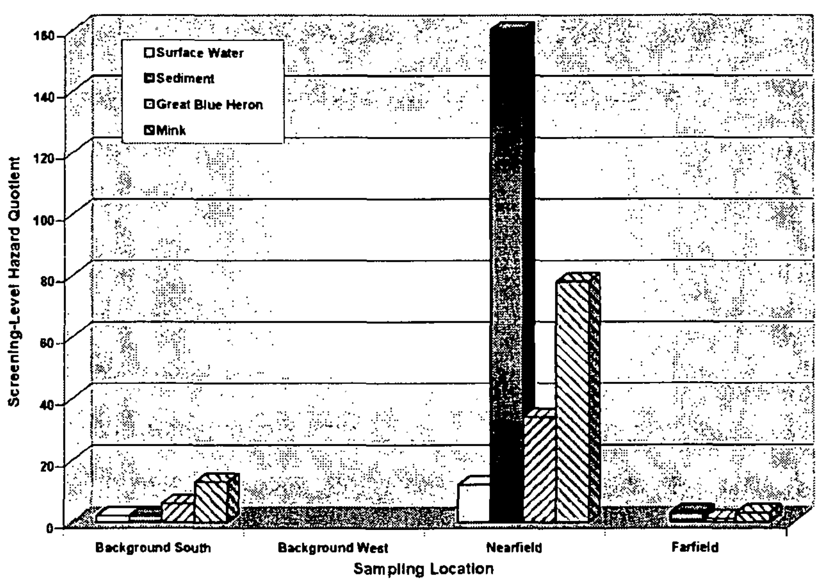

Figure ES-1-2. Hazard Quotients for Cadmium in Surface Water and Sediment, Western Drainage Area

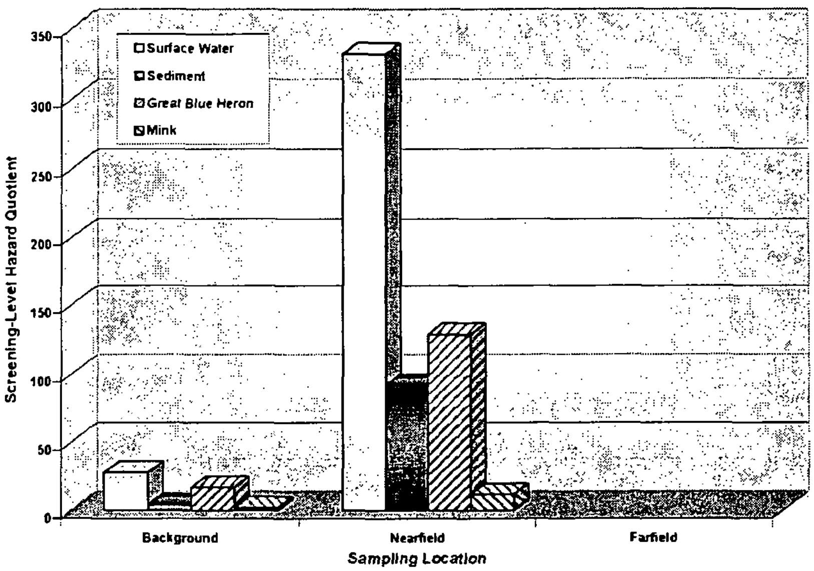

Figure ES-1-3. Hazard Quotients for Zinc in Surface Water and Sediment, Eastern Drainage Area

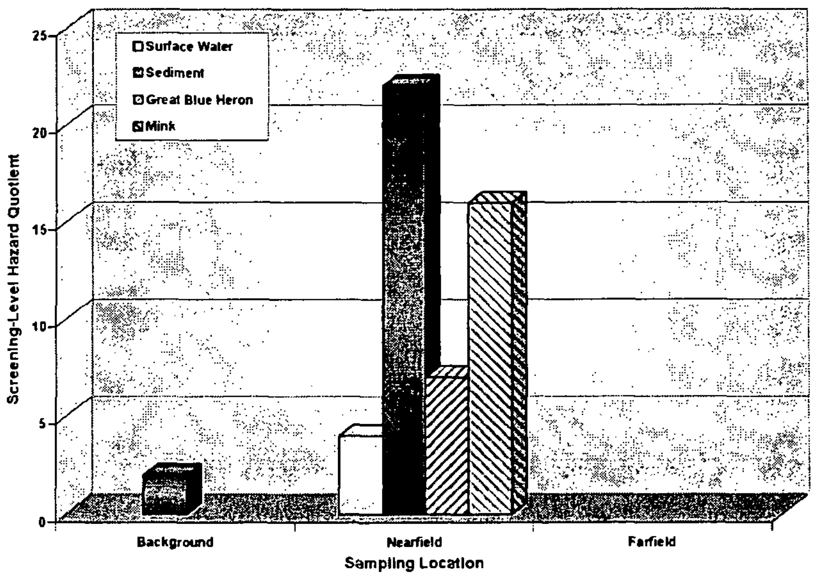

Figure ES-1-4. Hazard Quotients for Cadmium in Surface Water and Sediment, Eastern Drainage Area

2.0 INTRODUCTION

This report describes the results of a screening level ecological risk assessment (SLERA) for the Eagle Zinc Company site ("the Site"), located in the Township of Hillsboro, central Montgomery County, Illinois. The Site occupies approximately 132 acres situated on two parcels of land in a mixed commercial/industrial and residential area (Figure 2-1). An estimated 10 to 15% of the Site is covered by approximately 23 buildings. Other Site features include railroad spurs, residual material stockpiles, several paved and unpaved roadways, a southwestern stormwater retention pond, a pair of engineered stormwater retention ponds located near the eastern Site property boundary, and a small pond located between two railroad spurs near the entrance to the plant. According to former Eagle Zinc Company personnel, this pond was likely manmade and used for storage of water for fire fighting or other purposes. Historically, the undeveloped northern portion of the Site was used for agricultural production, which ceased in the 1980s.

A remedial investigation/feasibility study (RI/FS) is being performed for the Site in accordance with the December 31, 2001 Administrative Order on Consent between the Eagle Zinc Site Parties ("the Parties") and the United States Environmental Protection Agency (EPA). As stated in the RI/FS Work Plan (ENVIRON 2002b), the primary focus of the RI is to characterize the nature and extent of releases at the site, to assess potential migration pathways by which the Site-related chemicals could impact humans or valued ecological receptors, and to evaluate potential risks to those receptors. On behalf of the Parties, EnvironWMS has conducted this SLERA to evaluate whether valuable wildlife resources (receptors of concern [ROCs]) may be adversely impacted by exposure to Site-related chemicals of potential ecological concern (COPECs).

The objective of the SLERA process is to evaluate whether the potential exists for unacceptable risk relative to valuable ecological resources. The result of the SLERA is the first Scientific Management Decision Point (SMDP) in the ecological risk assessment process (EPA 1997a). To meet this objective, the purposes of this SLERA are to:

- Estimate the likelihood that the Site poses unacceptable risk to valuable ecological resources;
- Identify the need for additional Site-specific information for specific exposure pathways, if warranted; and
- Focus Site-specific follow-on ecological risk evaluation, if necessary.

2.1 Regulatory History

Zinc processing operations began in 1912, at which time the facility operated as a zinc smelter under the name Lanyon Zinc Company. Smelting products included zinc and sulfuric acid. In 1919, the Site was purchased by Eagle Picher Industries, which continued zinc smelting and manufactured sulfuric acid. Sometime after 1919, zinc oxide and leaded zinc oxide production commenced at the Site. The leaded zinc oxide production ceased around 1958; however, Eagle Picher continued to manufacture zinc oxide at the Site until November 1980. At that time, Sherwin-Williams purchased the Site and conducted manufacturing operations for less than one year. In 1984, the facility was sold to Eagle Zinc Company (now a Division of T.L. Diamond). Eagle Zinc primarily manufactured zinc oxide at the Site. Manufacturing operations permanently ceased at the Site at the end of 2002 (ENVIRON 2003a).

The Site was initially listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) on June 1, 1981 following a discovery action initiated during Site ownership by Sherwin-Williams. Sherwin-Williams notified EPA that the Hillsboro Site qualified as a Hazardous Waste Site, in accordance with Section 103(c) of CERCLA. Pursuant to this action, the Illinois Environmental Protection (IEPA) conducted several site investigations under Superfund. On May 22, 1998, Eagle Zinc entered into an Interim Consent Order, which contained an interim site plan, with the Illinois Attorney General and the IEPA, (ENVIRON 2002). All issues associated with the Interim Consent Order were resolved in the final Consent Order, dated January 7, 2002.

A RI/FS is being performed for the Site in accordance with the December 31, 2001 Administrative Order on Consent between the Parties and the EPA. As stated in the RI/FS Work Plan (ENVIRON 2002b), the primary focus of the RI is to characterize the nature and extent of releases at the Site, to assess potential migration pathways by which the Site-related chemicals could impact humans or valuable ecological receptors, and to evaluate potential risks to those receptors. The following reports have been submitted:

- A Preliminary Site Evaluation Report (PSER) was submitted to the EPA Region V and IEPA in March 2002 (ENVIRON 2002a). The PSER provides an overview of the Site and its history (operational and regulatory) as well as an evaluation of existing data. The PSER also provides an evaluation of soil, sediment, residue, surface water and ground water data available at that time and presents a list of potential chemicals of concern for each media, based on available data. Potential on-Site and off-Site exposure routes are also identified in the PSER. This information was incorporated into the conceptual model described in Section 4.4.

- The Phase 1 Technical Memorandum (ENVIRON 2003a) discusses the Phase 1 remedial investigation activities that were conducted in July 2002, including the surveying, and soil, sediment and residue investigations. Also included in the Phase 1 Technical Memorandum is a discussion of the nature and extent of contamination, based on an analysis of the soil, sediment and residue sampling results. The Phase 1 Technical Memorandum also includes a modified Site conceptual model, with the soil, sediment and residue information modified based on the Phase 1 sampling data for these media. The Phase 2 sampling program is previewed in the Phase 1 Technical Memorandum.
- The Phase 2 Technical Memorandum (ENVIRON 2003b) discusses the Phase 2 remedial investigation activities that were conducted in March 2003 and June 2003, including monitoring well and piezometer installation, water level measurement, ground water sampling, surface water sampling, supplementary residue sampling, and soil pH sampling. The Phase 2 Technical Memorandum includes an updated Site conceptual model with the ground water, surface water and residue information modified based on the Phase 2 results. In November 2003, additional surface water and sediment samples were collected from on-Site portions of the Western Drainage Area for analysis of volatile organic compounds. The sampling results were transmitted to the EPA with the January and February 2004 monthly progress reports.

2.2 Land Use

The Site was in continuous industrial use for 90 years (from 1912 until 2002); operations included zinc smelting, and manufacture of sulfuric acid, metallic zinc, zinc oxide and leaded zinc oxide. The undeveloped northern portion of the Site was historically used for agricultural production, which ceased in the 1980s. Current land uses and habitats at the Site are shown in Figure 2-2. Large areas are occupied by abandoned buildings and manufacturing facilities (10 to 15% of the Site area), large areas with residue piles, as well as former agricultural fields. Manufacturing areas, residue pile areas, raw material storage areas, railroad sidings, and other areas were cleared of trees, and other vegetation and soils were disturbed for industrial use, resulting in physical destruction of habitat.

The general area surrounding the Site is also characterized by intensive land use with a number of commercial/industrial facilities:

- North: Small facility, Hayes Abrasives; golf course; farm fields
- South: Small commercial/industrial facilities, including University of Illinois Extension office; Fuller Brothers Construction/Ready Mix; Hixson Lumber; Hillsboro Rental; Vogel Plumbing.
- East: Industrial Drive; an asphalt company; a railroad corridor; former Hillsboro Glass Company facility (now a steel warehouse)
- West: Some undeveloped land and a residential area containing single- and multi-family dwellings

The Site property is zoned for commercial/industrial use, and local officials have indicated to ENVIRON that there are no plans to re-zone the property for other uses. According to the Mayor of Hillsboro, Hon. William Baran, and the Chairperson of the Planning Committee, Thomas L. Gooding, when it is ready for reuse, the City plans to incorporate the Site into the City limits, obtain ownership of the property, and redevelop the property for commercial/industrial use. In a December 19, 2003 letter, Chairperson Gooding wrote:

> "The Hillsboro Planning Commission in its newly developed long term plan is recommending that the City of Hillsboro acquire the Eagle Zinc property for use as an industrial park subject to a mutually acceptable agreement with the current owner especially with respect to environmental aspects of the property. The acquisition will provide an additional tax base for the City as well as valuable railroad siding, building and real property."

The scenario envisioned by City officials includes an industrial park predominantly consisting of warehouses, potentially with some light industry. Development of a Master Plan for the entire City has been initiated, which will include the future redevelopment of the Site as a major component. Therefore, this

SLERA is based on the City's and owner's mutual intention that future land use at the Site will remain commercial/industrial.

As part of its Land Revitalization Agenda, EPA's Office of Superfund Remediation and Technology Innovation recently issued *Guidance for Preparing Superfund Ready for Reuse Determinations* (EPA 2004) (copies of this document and its transmittal memorandum are included in Appendix A) for facilitating productive reuse of industrial sites consistent with the reasonably anticipated future land use. The Ready for Reuse (RfR) Determination is an environmental status report that documents a technical determination by EPA that all or part of a Superfund site can support specified types of uses and remain protective of human health and the environment as long as all required response conditions and use limitations continue to be met. For example, an RfR Determination may:

- Provide one or more future owners/developers that would otherwise view the site as environmentally blighted and not worthy of redevelopment with EPA's concurrence that the site meets established criteria for commercial/industrial use, within the framework of controls that ensure continued protectiveness.
- Allows for the transferability of the RfR Determination, which is desirable, as the site ownership may change before or during redevelopment.
- Allow low impact or non impacted areas of the site to be issued an RfR Determination prior to the completion of response actions in other areas of the site. This is particularly relevant to the non-impacted Northern Area of the Eagle Zinc Site.
- Complement established site controls and link future site uses to the maintenance of those controls.

The Parties are willing to develop appropriate institutional controls, and view an RfR Determination for the Site for industrial/commercial use as a key component in its development for productive commercial/industrial reuse.

3.0 SLERA APPROACH

Ecological risk assessment is a process that evaluates the likelihood that adverse effects may occur as a result of an ecosystem's (or a component's) exposure to one or more environmental stressors (EPA 1998). Like human health risk assessment, its purpose is to provide information to help decide whether and what action is needed to avert or reduce risks. The two disciplines share many elements and techniques, and basic steps in the two processes are similar in concept.

However, several key differences between human and ecological risk assessment should be recognized. First, the subject of human health risk assessment is the human individual, but ecological risk assessment may focus on any one or any combination of ecological components. In general, loss of a few individuals of a species is unlikely to significantly diminish the viability of the population or disrupt the community or ecosystem of which they are a part. As a result, the fundamental unit for ecological risk assessment is generally the population rather than the individual, with the exception of protected (*e.g.*, threatened and endangered) species. Second, human health and ecological risk assessment processes focus on different endpoints (defined as characteristics or functions that may be adversely affected by exposure to site-related chemicals). The endpoints of human health risk assessment are relatively limited and well-defined (*e.g.*, cancer, systemic toxicity, developmental or reproductive effects); the endpoints for ecological risk assessment can be several, including mortality and effects on different species. Thus, due to the many different stressors, habitats, and historical elements that may be a part of, or contribute to, an ecological risk assessment, the process must be flexible while providing logical and scientific structure.

Finally, ecological risk assessors must be aware of the potential effects of not only chemicals, but also of physical and biological agents on ecological receptors. Physical stressors include global phenomena such as ozone depletion as well as local and regional phenomena such as habitat destruction or alteration by natural events (drought, fire) or human activities (industrial use, farming), and extremes of natural conditions (*e.g.*, temperature, moisture, water level, and flow rate). Potential biological stressors include disease and predation. Although current risk assessment practices focus primarily on chemical stressors, it must be emphasized that physical stressors are likely to be more significant than chemical stressors in areas of human habitation. maybe

SLERAs are often used as the first tier of the risk assessment process. Conservative assumptions regarding exposures and effects on receptors (such as aquatic organisms) are used to evaluate potential risk to receptors, thereby facilitating the appropriate conservative elimination of pathways from further evaluation when unacceptable risk is not indicated. Stressors and locations indicating potentially unacceptable risk should be evaluated further using additional site-specific information and more realistic assumptions, where possible. That is, a screening level risk assessment can support a conclusion that a particular chemical in a particular location poses insignificant risk to the selected receptors, or it can indicate potentially unacceptable risk and the need for additional evaluation.

The overall goal of the SLERA is to ensure that COPECs associated with former Site operations do not adversely impact water quality and habitat conditions in off-Site drainage areas. The general methods used in this ecological SLERA follow Steps 1 and 2 of the EPA guidelines for conducting ecological risk assessments at Superfund Sites (EPA 1997a): (1) screening-level problem formulation and ecological effects evaluation, and (2) screening-level exposure estimate and risk calculation. Reference is also made to other guidance documents as relevant (EPA 1997b, 1998, 2001a&b, 2003).

Figure 3-1 illustrates EPA's framework for risk assessments as applied to ecological risk assessments. Based on this framework, this assessment consists of four primary components: (1) Problem Formulation; (2) Exposure Characterization; (3) Effects Characterization; and (4) Risk Characterization. This SLERA comprises Steps 1 and 2 of the ERAGS process (Figure 3-2), the screening-level problem formulation, ecological effects evaluation, exposure estimate, and risk calculation, culminating in a clearly defined SMDP. The Problem Formulation focuses on describing the study area, and defining Site issues as they apply to management goals. The observations from the Site visits were used to support the selection of ecological receptors. The Exposure Characterization quantifies chemical exposures to the ecological receptors. The Effects Characterization presents the relevant toxicity thresholds or guidelines that are compared to the exposure estimates. The Risk Characterization quantifies screening potential risks by integrating the exposure and effects characterizations, as well as by considering other lines of evidence. Finally, the SMDP represents a critical step in the Ecological Risk Assessment process where results are presented and multi-stakeholder risk management decision-making occurs.

4.0 SCREENING-LEVEL PROBLEM FORMULATION

The purpose of this SLERA is to identify areas of potential Site-related risk to valuable ecological resources that may warrant further evaluation and/or remedial action. Because there is often a wide range of potential ecological effects at sites containing hazardous chemicals or other stressors, it is important to adequately define the scope and focus of the SLERA at the outset. Screening-level problem formulation includes stressor characterization, identification of COPECs and relevant ecological ROCs, selection of assessment endpoints and measures of exposure and effects, and development of an exposure pathway site conceptual model.

A key element of the screening-level problem formulation is an understanding of the setting of the Site and surrounding areas with respect to ecological resources. To this end, biologists have performed Site reconnaissances (in July 2002 and March 2004), and completed environmental check sheets that organize and summarize information regarding Site conditions (Appendix B). These check sheets facilitate understanding of the ecological setting, and provide the basis for identification of potentially complete exposure pathways and measurement endpoints, as discussed in the following sections.

4.1 Environmental Setting

The Site has been in continuous industrial use for over 90 years, as discussed in Section 2.02 and described in previous documents (ENVIRON 2002a&b and 2003a&b). The undeveloped northern portion of the Site was formerly in agricultural production, which ceased in the 1980s. Other Site features include railroad spurs, residual material stockpiles, several paved and unpaved roadways, a stormwater retention pond located in the southwestern corner of the Site, a pair of engineered stormwater retention ponds located near the eastern property boundary, and a small pond located between two railroad spurs near the entrance to the plant. According to former facility personnel, this pond was likely manmade and used for storage of water for fire fighting or other purposes.

Site visits were conducted by biologists on July 15, 2002 and March 3, 2004 to (1) assess the nature and quality of terrestrial and aquatic resources on and in the vicinity of the Site; (2) identify habitat types and their extent (Table 4-1); (3) identify species actually or potentially present on and in the vicinity of the Site; (4) identify COPECs and their potential migration pathways resulting in exposure of ecological receptors; (5) assess the potential for non-chemical stresses on and in the vicinity of the Site; and (6) document obvious environmental impacts and their likely causes.

Based on these Site visits and a review of available background documents, a check sheet was prepared, and a list of species observed during the Site visits was compiled (Table 4-2). These items as wells as correspondence indicating the absence of threatened and endangered species in the Site area are provided in Appendix B. Photographs from the Site visits are included in Appendix C. The following observations are relevant to evaluation of the Site with regard to potential ecological risk:

- Habitat types and quality in the vicinity of the Site are unremarkable and similar to that observed at the Site – no "sensitive habitats" as defined in EPA guidance (1997a) (Table 4-1) were observed (or would be expected) on or in the vicinity of the Site;
- No threatened or endangered species were observed, and none are expected within a mile of the Site boundaries, according to the Illinois Natural Heritage Database;
- Widespread physical disturbance and resultant habitat degradation is evident on-Site; and
- The off-Site Eastern and, in particular, Western Drainage Areas also exhibit impacts associated with the Site and other nearby commercial/industrial operations, but provide some aquatic and wildlife habitat for common regional species that were observed during the Site visits.

Note: future land use not necess. relevant on full plan; unless documents/legal restrictions

Narrative descriptions of on-Site and off-Site ecological resources are provided below.

4.1.1 Terrestrial Resources

The terrestrial habitat on and in proximity to the Site, which includes woods, old fields, and mixed woods and grasses, is not unique or unusual in the area. The trees north of the southwest stormwater pond are generally about 10 to 15 years old. There are some individual older trees on the fringes of this area, and in the northern portion of the property (locust, oak, other). There are no natural wetlands of appreciable size, threatened or endangered species, or

uniqueness doesn't necess. mean not valuable quality plant habitats on the Site. The species observed during the Site visit are all common and have access to superior habitat in the area. For example, the Bremer Sanctuary located just one mile north of Hillsboro provides 203 acres of oak-hickory upland, with ponds, a creek, and 40 acres of grasslands.

The photographs in Appendix C and Figure 4-1 document the fact that intensive industrial activities conducted at the Site over the past 90 years have resulted in marked physical disruption on and, to a lesser extent, in the vicinity of the Site, with resultant destruction and degradation of habitat and adverse ecological effects. For example, stands of trees in close proximity and north/northwest of the manufacturing area include some dead catalpas. These trees were observed to be dead in the late 1980s, although when and how they died is not known.

Figure 4-1 shows a number of Site features as well as the potential areas of concern identified as Areas 1 through 4 and the Western Area during the Phase 1 investigation (ENVIRON 2003a). In this sampling program, XRF screening results were used to select soil samples to be retained for target metals analysis. As indicated in Figure 4-1, two soil samples from the undeveloped northern area were analyzed at the laboratory, and neither contained elevated levels of target metals; the remainder were not analyzed at the laboratory due to low XRF screening results (ENVIRON 2003a). The fact that no soil impacts were identified in the northern area suggests that metals associated with residue piles in the industrially disturbed areas of the Site are not mobile. These data agree with the earlier observation that "much of the lead, cadmium, copper, and zinc, although high in concentrations in the dross, kiln residues and ore spoils, appears to be relatively inert and fixed in these materials" (RSI 1982). Thus, it appears that physical disturbance and soil impacts are closely associated with the presence of residue piles.

Activities on the Site had been declining over the past several years as industrial operations slowed down, and finally ceased in 2002. This decreasing human activity level has allowed some temporary intrusion by common opportunistic species such as deer and raccoons. However, these organisms, often considered to be nuisance species, do not constitute valuable ecological resources as defined in EPA guidance (EPA 2001). The physical condition of the disturbed portions of the Site precludes its functioning as a viable habitat for wildlife populations, communities, and ecosystems. Further, as discussed in Section 2.2, the Site is zoned for commercial/industrial use and

City plans call for compatible redevelopment. This indicates that redevelopment of the Site will preclude its restoration as functional habitat.

4.1.2 Aquatic Resources

According to the National Wetland Inventory (NWI) Map for Hillsboro, Illinois (U.S. Fish and Wildlife Service, 1988), the only mapped wetlands on the Site property include the southwest retention pond and the small man-made pond located in the southeast part of the Site. These ponds are mapped as "intermittently exposed palustrine wetlands with unconsolidated materials in diked or impounded areas." There is no apparent outflow from the small pond, and inflow appears to be via overland flow (channels were dry at time of July 2002 and March 2004 visits). In July, basking turtles were observed in the east end of the pond, as well as dragonflies and frogs. Floating algal mats in the pond were also noted. In March 2004, a frog was observed on one bank.

There are two primary drainage systems that run through the Site, as shown in Figure 4-2. One drainage flows in a southwesterly direction from the middle of the Site toward the southwestern boundary where there is a stormwater pond, about one acre in size. Downstream of the pond, the drainage flows westerly to a tributary stream that flows northerly to the Middle Fork Shoal Creek. This drainage is referred to as the "Western Drainage Area" in this report. The Eastern Drainage drains the northeastern corner of the Site, receives outflow from two connected stormwater retention ponds, and flows northeasterly from the Site, eventually entering Lake Hillsboro. This drainage is referred to as the "Eastern Drainage Area". In May 2003, the IEPA terminated the Site's National Pollutant Discharge Elimination System (NPDES) Permit, which regulated stormwater discharges from the former plant to both the eastern and western stormwater outfalls. The permit was terminated because, according to the IEPA's May 23, 2003 Public Notice/Fact Sheet of Intent to Terminate NPDES Permit No. IL0074519, "...the facility has closed, all industrial activity has ceased, and the discharges have ceased." None of the on-Site drainage features are of sufficient size or quality to support valuable ecological resources. However, the off-Site Western and Eastern Drainage Areas are further evaluated in this SLERA.

4.1.2.1 Western Drainage Area

The Western Drainage Area includes the southwestern retention pond (about one acre) that receives a portion of the Site's stormwater runoff. Large berms covered with residues, and other debris extend to the water's edge on the south and west sides of this pond. Upstream of the pond, the incoming stream flows through a swale. Man-made alterations, including a large concrete wall, were noted in this upstream area. The adjacent land to the north and west is mixed woods and grasslands, providing some songbird habitat. Floating algal mats and pondweed were observed in the pond, and surface water temperature was measured at approximately 30°C in July 2002, indicating stagnant conditions. Dragonflies were observed in this area in July, and fish (including fathead minnows [*Pimephales promelas]*, common shiner [*Luxilus cornutus]*, and green sunfish [*Lemomis cyanellus]* were seen in the pond. Green herons [*Butorides virescens])* were observed feeding at its upstream end. North of the pond there is a small area of mixed woods along the Site boundary. There is a small palustrine wetland at the upstream end of the pond, and a small wet area exists on the south side, dominated by common reeds (*Phragmites australis*). Songbirds, including northern cardinal, were heard and observed in the shrubby and wooded areas around the pond.

Stormwater intermittently discharges westward from this pond to a drainage swale, which joins a drainage from the south and flows through mixed woods before it discharges to an unnamed intermittent tributary of Middle Fork Shoal Creek. This outfall was formerly permitted with the IEPA Division of Water Pollution Control as NPDES Outfall 001. The outlet is currently constricted by residue piles, broken concrete, and other items. In March 2004, no flow from the outlet of the pond to the stream was observed, but seepage from the berm was noted, as well as evidence of overland flow (dry at the time of the July 2002 Site visit) to the stream. Despite the lack of evidence of direct flow to the stream from the pond in July 2002, there was water in the stream below the pond (a few inches deep), suggesting possible groundwater contributions. This was supported by the relatively cold temperature measured in the stream (15.2°C) in July. In

March, there was some flow from the pond as well as drainage, including overland flow, from the southern drainage ditches.

The drainage south of the Site was also dry at the time of the July 2002 visit, but there was flowing water in March 2004. This drainage appeared to have high iron concentrations (as did the mixed water in the drainage downstream), and a flocculation precipitate was observed. The source of the precipitate is unknown, but the fact that it had been observed upstream of the Site on prior occasions suggests that there may be upstream sources or causes of the observed precipitation.

The off-Site drainageway below the pond appeared to be heavily silted, with possible contributions from an adjacent site (concrete plant) to the south. In March 2004, filamentous algae in this drainage were widespread, but no other aquatic life was noted. Discarded plywood and other debris were observed. The stream temperature at the downstream end was 27°C in July 2002. The dilution potential at the confluence of the tributary to Middle Fork Shoal Creek at the time of the July 2002 survey was estimated at approximately 20-fold. Nettles (*Urtica dioica*), common reeds (*P. australis*), and juncus (*Juncus acuminatus*) were observed in the creek floodplain. Wildlife observations included whitetail deer tracks, raccoon tracks, turtle burrows, frogs, crayfish holes, and an eastern box turtle in a creek burrow.

4.1.2.2 Eastern Drainage Area

Stormwater that originates in most of the manufacturing areas and the eastern part of the Site enters an engineered stormwater retention system located near the eastern property boundary. The stormwater retention system includes a small concrete settlement structure and a two-cell, clay-lined retention pond installed in 2001, which occasionally discharges to a drainage swale that channels the stormwater off the Site property to the east and ultimately into Lake Hillsboro, approximately ½-mile east of the Site. Lake Hillsboro is a man-made reservoir, which discharges to Middle Fork Shoal Creek approximately one mile north of the Site.

In contrast to the Western Drainage Area, the Eastern Drainage Area was mostly dry at the time of the July 2002 Site visit. Where water stood in the stormwater retention ponds, it was very shallow (less than one foot), and water temperature was high (34 °C). There were black exposed sediments with some ponded water in the other areas of the ponds. Extreme algal blooms and some frogs were observed. In March 2004, water filled both ponds, water flowed in the drainage ditches, and the drainage area was very wet. The downstream drainage from the most northerly stormwater basin meets with the north drain (a defined dry vegetated channel at the time of the survey in July 2002; very wet in March 2004) and flows off-Site toward Lake Hillsboro. The flow through this stream was very low at the time of the July 2002 Site visit, but there was some standing water observed in pools. In March 2004, there was flowing water in this drainageway. Some small fish (centrarchids), damselflies, crayfish burrows, and sunfish were observed in a pool in July 2002, when the water temperature was approximately 22°C. Deer and raccoon tracks were observed in the area, as well as songbirds.

4.1.2.3 Aquatic Background Areas

Areas selected to represent background conditions (Middle Branch Shoal Creek and Middle Branch Cress Creek ([Bremer Sanctuary]) were visited in July 2002. The measured temperatures in these streams were generally around 25°C, and the water was clear without the siltation and precipitate that were observed in the Western Drainage Area of the Site. Mussels and fingernail clams were observed in both background areas, organisms that were not observed on or in the vicinity of the Site.

4.2 Fate and Transport Pathways

Potential migration pathways at the Site were evaluated in the Phase 2 Technical Memorandum (ENVIRON 2003b). With the exception of a limited area where chlorinated volatile organic compounds were detected in sediments and surface water, the COPECs in Site media are all metals. The concentration and distribution of these metals in environmental media on and in the vicinity of the Site could be (and/or could historically have been) affected by one or more of the following general mechanisms, as illustrated in Figure 4-3 and Figure 4-4:

- Suspension and transport of COPECs in air;
- Suspension and transport of COPECs in surface water runoff;
- Leaching of COPECs from residue piles to underlying soil and
- groundwater;
- Migration of COPECs in groundwater; and
- Groundwater-to-surface water transport of COPECs.

EnvironWMS performed a detailed evaluation of available historical data for the Site, including the off-Site soil data collected by IEPA in 1993 as part of the CERCLA Expanded Site Inspection (ESI). As discussed in the Phase 1 Technical Memorandum (ENVIRON 2003a), available data and information concerning the residue piles do not suggest that air deposition has impacted nearby off-Site areas. The prevailing wind direction is from the south and south-southwest. Therefore, any impact would be expected to be greatest in the area immediately north or north-northeast of the areas used for residue storage. Inspection of western and northern property boundaries during the Phase 1 field activities showed no evidence of deposited residues in these areas or in adjacent off-Site areas. A previous investigation conducted by IEPA addressed this issue through the collection of off-Site surface soil samples. As discussed in the PSE Report (ENVIRON 2002a), no constituent concentrations detected in off-Site soils were determined to be significantly different from relevant background levels. As the off-Site soil samples collected by IEPA in 1993 were well-distributed around the Site, the available data do not indicate that off-Site migration of COPECs through wind deposition has occurred.

The predominant topographic slope of the Site is southerly, and the southwestern stormwater pond receives a large proportion of the Site's stormwater runoff. As described in Section 4.1.2.1, stormwater intermittently discharges westward from this pond to a drainage swale, which in turn discharges to an unnamed intermittent tributary of Middle Fork Shoal Creek. Middle Fork Shoal Creek flows southwestward and joins Shoal Creek approximately six miles southwest of the Site. As described in Section 4.1.2.2, the eastern stormwater retention system discharges to a drainage swale that channels the stormwater off the Site property to the east and ultimately into Lake Hillsboro, approximately ½-mile east of the Site. As a result, surface water impact could occur due to COPECs being carried off-Site in stormwater runoff (Figure 4-3 and Figure 4-4). However, NPDES sampling at the surface water outfalls conducted prior to permit cancellation in May 2003 demonstrated that current conditions on the Site would not result in off-Site impacts. Therefore, off-Site impacts may have been related to historical surface water runoff from the Site rather than ongoing discharges.

The bulk of the Site's groundwater is believed to flow either southwestward (towards and parallel with the Western Drainage Area) or eastward/southeastward (towards and parallel with the Eastern Drainage Area) (ENVIRON 2003b) (Figure 4-3 and Figure 4-4). Discharge of groundwater into surface water bodies could also be a source of COPECs to off-Site surface water bodies. On-Site areas within the Eastern Drainage Area include large non-operational areas (*e.g.*, Northern Area and areas east of the Manufacturing Area) and lack significant source areas, such as residue piles. The fact that no dissolved metals were detected above applicable groundwater screening levels in these wells (ENVIRON 2003b) reflects the known lack of source areas that could impact groundwater in the areas east of the Site. Thus, available data indicate that groundwater flow to the Eastern Drainageway and Lake Hillsboro is not a significant transport pathway. Based on the limited off-Site extent of groundwater impacted by dissolved metals concentrations to the southwest of the Site, it is similarly concluded that groundwater discharge is not a significant pathway for the off-Site transport of COPECs to the southwest.

In summary, based on data reviewed and presented in the ENVIRON Site investigation reports (ENVIRON 2002a&b 2003a&b), off-Site transport of COPECs via air is not significant. Groundwater discharge to surface water similarly does not appear to be a complete pathway for off-Site transport of COPECs in either the Eastern or Western Drainage Areas. NPDES sampling data indicated that surface water runoff does not transport significant amounts of COPECs off-Site into the Eastern Drainage Area. Although outfall sampling has not documented significant releases, limited discharge of COPECs may occur along with intermittent outflow of water from the southwestern pond into the Western Drainage Area.

4.3 Identification of Study Areas for the SLERA

As discussed in Section 4.1, Site visits have documented the fact that aquatic and terrestrial habitats on and around the Site are not unique or unusual in the area.

There are no natural wetlands of appreciable size, threatened or endangered species, or quality plant habitats. The species observed during the Site visits are all common and have access to abundant superior habitat in the area.

Historic intensive industrial use of the Site and its general vicinity have resulted in significant physical disturbances to on-Site habitats. Elevated metals levels in soils are closely associated with the presence of residue piles, but available data indicate that mobility is limited. That is, elevated metals concentrations are spatially coincident with disturbance in developed areas of the Site. On-Site waterways and ponds are not natural water bodies but rather man-made structures designed for collection and management of stormwater runoff, a function they continue to serve.

As acknowledged in EPA guidance (1997a), "Many hazardous waste sites exist in currently or historically industrialized or urbanized areas. In these instances, it can be difficult to distinguish between impacts related to contaminants from a particular site and impacts related to non-contaminant stressors or to contaminants from other sites." Further, when "...sites are located in highly industrialized areas where there could be few if any ecological receptors or where site-related impacts might be indistinguishable from non-Site-related impacts...remediation to reduce ecological risks might not be needed. However, all sites should be evaluated by qualified personnel to determine whether this conclusion is appropriate" (EPA 1997a).

Neither the laws that direct the EPA's activities nor the EPA's current guidance specifies exactly what ecological resources require protection or restoration. Because the choice of priorities for protection is critically important if an ecological risk assessment is to be useful in making risk managers' decisions, the EPA has begun developing processes for identification of appropriate objectives and priorities (EPA 1997b, 2001). A recent review of current practice suggested eight ecological entities that are of widespread concern: (1) aquatic communities in lakes, streams, and estuaries; (2) regional populations of native species and their habitats; (3) severe episodic threats (such as massive bird or fish kills); (4) important ecosystems functions and services; (5) wetlands; (6) endangered ecosystems; (7) endangered species and their habitats; and (8) other special places (EPA 1997b). Of these eight ecological entities, the only one potentially relevant to the Site is off-Site aquatic communities in the Eastern and Western Drainage Areas.

In summary, the available on-Site habitat is not of the size, quality, and type that is supportive of sustainable wildlife populations, communities, and ecosystems.

somewhat contradicted by photos + surveys but not legally closed, restricted? → check

In view of the current and future commercial/industrial land use, such habitat is unlikely to be provided in the future. On these bases, evaluation of potential chemical impacts to limited on-Site aquatic and terrestrial resources was not considered to be an appropriate objective for the SLERA. Therefore, and in keeping with provisions in the guidance for consideration of site conditions (EPA 1997a), relevant and/or significant on-Site terrestrial and aquatic habitat and associated receptors were not identified. A similar approach has been taken at other sites in EPA Region 5 (Appendix D).

However, nearby off-Site areas that may have been impacted by Site activities are potentially supportive of valuable ecological resources. Therefore, the primary focus of this SLERA is evaluation of potential Site-related impacts on off-Site ecological resources. Due to their distinct characteristics in terms of habitat and chemical concentrations, the Eastern and Western Drainage Areas were considered separately in the SLERA. Within each drainage, near- and farfield areas were identified as shown in Figure 4-2 (depicting locations of surface water stations) and Figure 4-5 (depicting locations of sediment stations). The groupings of surface water and sediment stations are also listed in Table 4-3. In addition, background areas were defined for each of the drainages.

4.4 Preliminary Exposure Pathway Conceptual Site Model

Based on information collected during the Site visits and a review of available documents, a preliminary exposure pathway conceptual site model (CSM) was developed (Figure 4-6). This model depicts the transport of COPECs from source media to exposure media and relevant ROCs.

4.4.1 Chemicals of Potential Ecological Concern in Surface Water and Sediment

Although Site investigation data indicate little potential for off-Site migration under current conditions (ENVIRON 2003b; see Section 4.2), historical releases appear to have impacted off-Site surface water and sediment.

Analytical data for surface water and sediment were available for various on-Site and off-Site locations (ENVIRON 2003a). For Lake Hillsboro, surface water data were obtained from IEPA (2004). As discussed in ENVIRON (2003b), with the exception of a limited area where chlorinated volatiles were detected in sediments and surface water, the COPECS in Site media are all metals.

EPA guidance (1997a) prescribes use of maximum concentrations in SLERAs. Therefore, a data set for use in the SLERA was developed by screening surface water and sediment data to identify analytes that were measured above the detection limit at least once, including those flagged with a J value. Only data flagged with "R" (rejected) or flagged with "A" that were less than three times the level recorded in the method blank were eliminated from further consideration. Based on these considerations, the following preliminary list of COPECs in off-Site sediment and surface water was prepared:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Mercury
- Nickel
- Potassium
- Selenium
- Silver
- Vanadium
- Zinc
- Sodium
- Sulfate

4.4.2 Selection of Receptors of Concern and Potentially Complete Exposure Pathways

Given the complexity of ecosystems, an ecological risk assessment may focus on any one or any combination of ecological components. In general, loss of a few individuals of a species is unlikely to significantly diminish the viability of the population or disrupt the community or ecosystem of which it is a part. As a result, the fundamental unit for ecological risk assessment is generally the population rather than the individual, with the exception of protected organisms (*e.g.*, threatened and endangered species). In considering priorities for ecological risk assessment, EPA (1997b) recently proposed four criteria for identifying ecological entities to be protected:

- Legally mandated protection (*e.g.*, organisms protected under the Endangered Species Act);
- Organisms with special societal value (*e.g.*, game species);
- Rare or under threat, apart from species under mandated protection (*e.g.*, species whose habitats are declining);
- Ecological significance (*i.e.*, organisms that help sustain the ecosystem).

As noted previously, no rare or threatened protected species were observed or are expected to be present on or near the Site, and size of the off-Site areas impacted by historical releases is too small to provide important habitat for game species (Section 4.1, Appendix B). Based on the remaining criterion of ecological significance, the relevant ROCs identified for the SLERA are: [illegible]?

- Water column- (pelagic) and sediment-dwelling (benthic) aquatic biota that are in direct contact with impacted media and include all levels of the aquatic food chain, and
- Piscivorous birds and mammals that as high trophic-level predators in the aquatic food chain have relatively high potential for exposure to COPECs in aquatic media.

The general types of receptors selected for evaluation and potentially complete and significant exposure pathways are summarized in Table 4-4.

Benthic macroinvertebrate communities were selected for evaluation because they live in direct contact with COPECs in sediments, and provide an important source of food for fish and wildlife. Hence, the benthic macroinvertebrate community is important to the functioning of the entire aquatic community. Pelagic receptors span the range of ecological trophic levels, and serve as important food sources for terrestrial animals that feed in the aquatic food web (piscivores).

Because ecological screening levels for surface water and sediment are based on protection of the most sensitive species, selection of single ROCs living in these media is not necessary. To evaluate potential effects on piscivorous predators, one representative bird and one representative mammal that feed on fish and aquatic organisms were selected. A species of small heron, likely green heron (*B. virescens*), was observed during the July 2002 site visit. The great blue heron (*Ardea herodias*) rather than the green heron was selected for this assessment because of the ready availability of benchmarks for this species. These two birds share many common traits, and similar behaviors; further, the great blue heron is a common migrant and locally common summer resident in Illinois (Illinois Audubon 2004).

There are limited mammals in the area that consume fish and other aquatic organisms. The mink *(Mustela vison)* was selected because it is a high-trophic level carnivore, with food items including frogs, mice, rats, fish, rabbits, crayfish, birds, squirrels, and muskrats. While of mink were observed during Site visits, and it is not known if mink inhabit the area in the vicinity of the Site, they are known to live along rivers, streams, lakes, ponds, and marshes of Illinois (Illinois Natural History Survey 2004).

It is important to recognize that although only two specific ROCs were selected for evaluation in the SLERA, these organisms represent species that are likely to receive the highest exposures to COPECs. This practice ensures that lesser-exposed species have been adequately considered.

4.5 Selection of Assessment and Measurement Endpoints

Assessment endpoints are defined in EPA guidance as "the valued attributes of ecological entities upon which risk management actions are focused" (EPA 2003). Measurement endpoints are the measurable characteristics that are related to the valued attribute chosen as the assessment endpoint (EPA 1997a). In this SLERA, generic assessment endpoints were identified, and evaluated by calculating the ratio of water and sediment concentration data to generic guideline levels in surface water in sediment based on receptor toxicity data. Table 4-5 summarizes the assessment and measurement endpoints used in the SLERA.

5.0 SCREENING-LEVEL ECOLOGICAL EFFECTS EVALUATION

This section presents and discusses the generic screening guidelines in surface water and sediment that were used for the SLERA.

5.1 Aquatic Receptors

5.1.1 Surface Water

General use water quality standards in Title 35 of the Illinois Administrative Code were preferentially used to evaluate potential risks to pelagic organisms. These water quality criteria (WQC) are analogous to national WQC that are designed to protect 95 percent of the species in a generic aquatic community. If Illinois WQC were not available, then EPA recommended national WQC were used (EPA 2002). The lowest value (typically the chronic value for aquatic life) was selected as the screening threshold for this SLERA. The Illinois and EPA WQC used in the SLERA are presented in Appendix E.

For many metals, WQC are hardness-dependent. Generally speaking, a decrease in water hardness results in an increase in the bioavailability and, subsequently, the toxicity of certain divalent metals. Thus, the lower the hardness, the lower the WQC. Hardness was calculated for each area using available magnesium and calcium data and applying the following equation (APHA, 1989):

$$\text{Hardness}\left(\frac{\text{mg}}{\text{L}}\text{CaCO}_3\right) = 2.497 \times [\text{Calcium}] + 4.118 \times [\text{Magnesium}] \qquad \{1\}$$

5.1.2 Sediment

Illinois does not currently have recommended sediment quality values for assessing sediment impacts from chemicals to aquatic life or wildlife, but several other sources of freshwater sediment quality guidelines are available, including: Consensus #s. diff?

- Ingersoll *et al.* (1996),
- Environment Canada (1995), and
- Persaud *et al.* (1993) ("Ontario guidelines").

These are generic guidelines that have been derived to protect organisms that live and feed in direct contact with sediment (*i.e.*, benthos). The references consulted include guidelines representing sediment concentrations where there is a low likelihood of adverse effects (*e.g.*, Effects Range Low [ERL] and Threshold Effect Levels [TEL]), as well as concentrations where adverse effects are more likely to occur (*e.g.*, Effects Range Medium [ERM], Probable Effects Levels [PELs] and Lowest Effects Levels [LELs]). None of these guidelines account for site-specific conditions that affect the bioavailability of COPECs. LELs from the Ontario guidelines were selected for use in the SLERA, becuase they are generally the most stringent of the guidelines. All sediment guidelines from these consulted sources are presented in Appendix E.

Sediment data were also compared to classification levels presented in IEPA's *Evaluation of Illinois Sieved Stream Sediment Data; 1982-1995* (1997). This document describes a classification of sieved sediment data (*e.g.*, non-elevated, elevated, and highly elevated) based on a large dataset of sediments collected throughout Illinois. The intent of the classification was to have a means of identifying sediments that are elevated above natural levels in Illinois, and to compare recent data to historical unsieved data to assess trends. The classification presented in the report is for sieved sediments (provided in Appendix E), but a classification for unsieved sediments in Illinois developed by Kelly and Hite (1984) is also included as in Appendix E. The Kelly and Hite unsieved values were used for comparison, because the sediment data collected for the Eagle Zinc site were unsieved.

5.2 Piscivores

Sample *et al.* (1996) developed conservative toxicological benchmarks for a variety of COPECs in surface water that are protective of piscivores exposed via drinking water and ingesting aquatic prey. These values are derived by the following equation, assuming that the concentration of the COPEC in dietary items obtained from a water body is proportional to the COPEC concentration in the water:

$$\text{Surface Water Benchmark}_{COPEC/ROC}\left(\frac{mg}{L}\right)=\frac{NOAEL_{COPEC/ROC}\times BW_{ROC}}{W+\left(F\times BCF_{COPEC}\right)} \quad \{2\}$$

where:

$NOAEL_{COPEC/ROC}$	=	No-observed adverse effect level of COPEC for ROC (mg/kg-day)
BW_{ROC}	=	Body weight of ROC (kg)
W	=	Daily water consumption rate for ROC (L/day)
F	=	Daily prey consumption rate for ROC (kg prey/day)
BCF_{COPEC}	=	Water:tissue bioconcentration factor for COPEC in prey

The toxicological benchmarks used in the SLERA are provided in Appendix E.

6.0 SCREENING-LEVEL EXPOSURE ESTIMATES

Surface water and sediment data were collected by ENVIRON as part of the Remedial Investigation (ENVIRON 2003a) at the following locations depicted in Figure 4-2 (surface water) and Figure 4-5 (sediment):

- East background;
- East off-Site nearfield;
- East off-Site farfield (Lake Hillsboro);
- West background tributary to the south of the Site;
- West background tributary to the west of the Site;
- West off-Site nearfield; and
- West off-Site farfield (Middle Fork Shoal Creek).

All sediment samples were collected in July 2002, and surface water samples were primarily collected in March 2003. Generally, only one sample was collected at each location, although field duplicates were collected at some locations and one surface water location was resampled in June 2003.

For those analytes that were measured above the detection level, summary statistics were calculated (mean, standard deviation, minimum, maximum, count). Summary statistics for water and sediment analytes by area, as well as notes and any flagged data, are provided in Appendix F. The maximum detected concentrations of COPECs in each medium were used to estimate worst-case exposures to ROCs.

6.1 Aquatic Receptors

Potential risks to aquatic life were evaluated at the community level through direct exposures of benthic and pelagic organisms to COPECs in surface water or sediment. Thus, exposure was estimated by directly using maximum detected concentrations in surface water and sediment.

6.2 Piscivores

As discussed in Section 5.2, surface water benchmarks for piscivores were developed based on COPEC- and ROC-specific toxicity criteria, COPEC-specific bioconcentration factors, and ROC-specific body weight and intake characteristics (water and prey ingestion) (Sample *et al.* 1996). As for aquatic receptors, maximum detected COPEC concentrations were used to estimate exposure to these receptors.

7.0 SCREENING-LEVEL RISK CALCULATIONS

The screening-level risk characterization integrates the Effects and Exposure characterizations (Sections 5.0 and 6.0, respectively) to assess whether COPEC concentrations have any potential to adversely affect the selected ROCs. Potential risks were characterized by computing hazard quotients (HQs) for each COPEC/ROC pair. An HQ is the ratio of the maximum COPEC concentration in a medium to the corresponding benchmark. It should be emphasized that because SLERAs are intentionally designed to overestimate rather than underestimate potential exposure and risk, exceedance of the benchmarks (*i.e.*, HQ greater than 1) does not indicate a particular level or type of risk. It is not possible to reasonably differentiate chemicals as posing low, moderate, or high risk for those with HQs greater than 1, because the conservatism in the data and assumptions used are dependent upon a complex array of chemical-, species-, individual-, and site-specific variables. As COPECs whose concentrations are below the benchmarks (*i.e.*, HQ less than 1) are highly unlikely to result in significant risks, they may be confidently eliminated from further consideration. COPECs whose concentrations exceed the benchmarks may be evaluated in a more realistic, site-specific manner to more precisely characterize the nature and magnitude of potential risks they may pose.

The methods for computing HQs and the risk characterization results are described below.

7.1 Aquatic Receptors

Potential risks to aquatic life were characterized by computing HQs for each COPEC/ROC pair as the ratio of maximum surface water or sediment concentrations to generic water quality standards or sediment guidelines. In addition, off-Site sediment data were compared with classification levels presented in IEPA's *Evaluation of Illinois Sieved Stream Sediment Data; 1982-1995* (1997).

Water and sediment-based HQs for aquatic life were calculated for each area as follows:

$$\text{Water HQ}_{\text{COPEC/ROC}} = \frac{[\text{COPEC}_{\text{max}}] \text{ in water}}{\text{WQC}_{\text{COPEC/ROC}}} \qquad \{3\}$$

$$\text{Sediment HQ}_{\text{COPEC/ROC}} = \frac{[\text{COPEC}_{\text{max}}] \text{ in sediment}}{\text{Sediment Guideline}_{\text{COPEC/ROC}}} \qquad \{4\}$$

Results for the Eastern and Western Drainage Areas are discussed separately in the following sections. HQs calculated for all COPECs are presented in Appendix G.

7.1.1 Western Drainage Area

Surface water and sediment HQs in excess of 1 for the Western Drainage Area are summarized in Table 7-1. A slightly elevated HQ for aluminum was observed in farfield sediment, but not in surface water, and in neither medium at the nearfield and background locations. Arsenic HQs in sediment (but not surface water) were increased to the same minor extent in both the background south and nearfield locations. These results are not suggestive of a Site relationship for either metal.

The iron HQs in surface water are difficult to evaluate because the only available WQC is for dissolved rather than total iron (the measured quantity). The HQ for iron exceeds to a similar extent (greater than 10) at both the background south location, where presumed iron precipitate was observed during the Site visits, and the farfield location; it is lowest (HQ = 3) at the nearfield. A similarly slight elevation of the sediment HQ was observed in the nearfield, but not at the background or farfield sites where the surface water HQs were more elevated. Although not conclusive, these results are not suggestive of an exclusive Site relationship.

An HQ of 7 was calculated for mercury in nearfield sediment, but HQs for this metal were below 1 in both media at all other locations. Copper and lead HQs in sediment displayed similar patterns of slight elevation at the background south and farfield locations, with higher levels at the nearfield. However, HQs for neither were increased in surface water samples from these locations, suggesting low bioavailability to the water column.

Cadmium and zinc HQs were clearly elevated in both surface water and sediment in the nearfield, with lower exceedances in the background south and farfield locations. The zinc HQ for sediment was also greater than 1 at the background west location (the only exceedance observed in either medium there). The pattern for these metals indicates attenuation with distance from the Site.

but still elevated in all

This doesn't seem relevant?

7.1.2 Eastern Drainage Area

Surface water and sediment HQs in excess of 1 for the Eastern Drainage Area are summarized in Table7-2. Copper, lead, and manganese

HQs were all slightly elevated in nearfield sediment, but not surface water, while the HQ for nickel was slightly elevated in nearfield surface water but not sediment. These low exceedances in one medium are not suggestive of excessive concentrations of these metals, or of adverse effects associated with them.

qualifying such as "low" "slight" contradict previous statement that [illegible] in SLERA

The HQ for cadmium was slightly elevated in nearfield surface water, and somewhat more in nearfield sediment. However, a slight elevation was also observed in background sediment. Zinc HQs were substantially elevated in both nearfield surface water and sediment, but not in the farfield location, indicating that zinc concentrations attenuate rapidly with distance from the Site.

7.2 Piscivores

Potential risks to piscivorous birds and mammals were characterized by computing HQs for each COPEC/ROC pair as the ratio of maximum COPEC concentration in surface water to the corresponding benchmark from Sample *et al.* (1996):

$$\text{Water HQ}_{COPEC/RPC}\left(\frac{\text{mg}}{\text{L}}\right) = \frac{[\text{COPEC}_{max}]\text{in water}}{\text{Benchmark}_{COPEC/ROC}} \qquad \{5\}$$

Results for the Eastern and Western Drainage Areas are discussed separately in the following sections. HQs calculated for all COPECs are presented in Appendix G.

7.2.1 Western Drainage Area

Surface water and sediment HQs in excess of 1 for the Western Drainage Area are summarized in Table 7-3. Aluminum HQs were elevated for the mink (but not the great blue heron) at all sampling locations except the nearfield, reinforcing other observations suggesting that this metal is not Site-related. As observed for aquatic receptors in surface water and sediment, cadmium and zinc HQs were elevated in the nearfield. The great blue heron HQ for zinc was also elevated at the farfield location.

7.2.2 Eastern Drainage Area

Surface water and sediment HQs in excess of 1 for the Eastern Drainage Area are summarized in Table 7-4. The fact that similar exceedances for aluminum were observed in both background and nearfield suggest that the presence of this metal is not Site-related. As discussed in Section 7.1.2, cadmium and zinc HQs were more elevated in the nearfield than at the background location, but HQs were less than 1 in the farfield location. No exceedances were observed at the farfield location, reflecting attenuation of COPEC concentrations with distance.

7.3 Summary

In a SLERA, risks are typically quantified by calculating an HQ and comparing that HQ to a standard point-of-departure (often a value of 1). COPECs with HQs less than 1 are not evaluated further, while those with HQs greater than 1 may be retained for further evaluation. For this SLERA, a few inorganic analytes were detected at maximum concentrations that are associated with HQs greater than 1. As noted previously and further discussed in Section 7.4, it is important to recognize that the interpretability of such screening-level HQs is limited: while levels below 1 can be ~~confidently~~ considered ~~safe~~, exceedance of 1, even by a large to have little to no risk margin, does not necessarily indicate the existence of adverse effects. Nonetheless, this approach provides a rational and consistent basis for performing a preliminary evaluation of potential impacts on ecological resources. Major results of the SLERA are discussed below.

At the Western Drainage Area nearfield sampling location, HQs for zinc and cadmium were clearly elevated for all receptors (Figure 7-1 and Figure 7-2). HQs for lead and copper were elevated in sediment but not surface water, suggesting that these metals may not be bioavailable. As shown in Figure 7-1 and Figure 7-2, all zinc and cadmium HQs declined markedly with distance, indicating attenuation. A similar pattern of decline was seen for lead and copper in sediment. This indicates that ecological impacts in the offsite Western Drainage Area associated with Site-related COPECs, if any, are limited in spatial extent.

At the Eastern Drainage Area nearfield location, HQs for zinc and, to a lesser extent cadmium, were also elevated for all ROCs. However, the HQs at the farfield location were not elevated, indicating attenuation of levels with distance (Figure 7-3 and Figure 7-4). This indicates that ecological impacts in the offsite Eastern

Drainage Area associated with Site-related COPECs, if any, are relatively limited in spatial extent.

In summary, the results of the SLERA indicate that the potential for adverse impacts to ecological receptors in both Western and Eastern Drainage Areas, if any, would likely be associated with the presence of zinc and cadmium in surface water and sediment, and is of limited spatial extent. → few samples means less than full characterization

7.4 Uncertainties

Uncertainty, defined by EPA (1997a) as "imperfect knowledge concerning the present or future state of the system under consideration; a component of risk resulting from imperfect knowledge of the degree of hazard or of its spatial and temporal distribution" may theoretically lead to either an overestimate or underestimate of risk are associated with each stage of risk assessment. Due to the multiplicity of potential receptor species, general lack of knowledge regarding their life cycles, feeding habits, relative toxicological sensitivity, and the complexity and variability of interactions among ecological components, the uncertainty surrounding estimates of potential ecological risk may be substantially greater than those associated with human health risk assessment.

For this reason, SLERAs address uncertainties by managing them in a uniformly precautionary manner, resulting in unquantifiable but possibly substantial overestimation of exposure and risk. Uncertainties associated with each element of the SLERA process, and the anticipated effects of SLERA assumptions on outcome are identified and briefly discussed in Table 7-5.

8.0 SCIENTIFIC MANAGEMENT DECISION POINT

The results of this SLERA indicate that elevated HQs for selected ROCs in the nearfield Western and Eastern Drainage Areas are related to locally elevated levels of zinc and cadmium in surface water and sediment. Therefore, additional information may be necessary to determine what if any further evaluation of Off-Site surface water and sediment is warranted for protection of valuable ecological resources.

9.0 REFERENCES

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TABLES

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TABLE 4-1
List of Sensitive Habitats in the Hazard Ranking System[a]

• Critical habitat for Federal designated endangered or threatened species • Marine Sanctuary • National Park • Designated Federal Wilderness Area • Areas identified under the Coastal Zone Management Act • Sensitive areas identified under the National Estuary Program or Near Coastal Waters Program • Critical areas identified under the Clean Lakes Program • National Monument • National Seashore Recreational Area • National Lakeshore Recreational Area • Habitat known to be used by Federal designated or proposed endangered or threatened species • National Preserve • National or State Wildlife Refuge • Unit of Coastal Barrier Resources System • Coastal Barrier (undeveloped) • Federal land designated for protection of natural ecosystems • Administratively Proposed Federal Wilderness Area • Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or • coastal tidal waters • Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time • Terrestrial areas utilized for breeding by large or dense aggregations of animals • National river reach designated as Recreational • Habitat known to be used by state designated endangered or threatened species • Habitat known to be used by species under review as to its Federal endangered or threatened status • Coastal Barrier (partially developed) • Federally-designated Scenic or Wild River • State land designated for wildlife or game management • State-designated Scenic or Wild River • State-designated Natural Areas • Particular areas, relatively small in size, important to maintenance of unique biotic communities • State-designated areas for protection or maintenance of aquatic life • Wetlands
[a] From U.S. EPA (1997a).

TABLE 4-2
Species or Sign Observed During July 15, 2002 and March 3, 2004 Eagle Zinc Company Site Visits

Common Name	Scientific Name
Fish	
Fathead minnow	*Pimephales promelas*
Green sunfish	*Lepomis cyanellus*
Common shiner	*Luxilus cornutus*
Amphibians	
Green frogs	*Rana clamitans*
Reptiles	
Eastern Box Turtle	*Terrapene carolina*
Birds	
Green heron	*Butorides virescens*
Songbirds (including northern cardinal)	*Cardinalis cardinalis*
Mallards (flying over the site)	*Anas platyurhynchos*
Canadian geese (flying over the site)	*Branta canadensis*
Mammals	
Whitetail deer (tracks)	*Odocoileus virginianus*
Raccoon (tracks)	*Procyon lotor*
Plants	
Cottonwood Trees	*Populus deltoides*
Locust Trees	*Robinia pseudoacacia*
Catalpa Trees	*Catalpa*
Oak Trees	*Quercus*
Willow Trees	*Salix nigra*
Pondweed	*Potamogeton pectinatus*
Nettles	*Urtica dioica*
Common reed	*Phragmities australis*
Juncus	*Juncus acuminatus*
Sedge	*Carex*
Invertebrates	
Dragonfly	Order: Odonata
Damselfly	Order: Odonata
Crayfish	Family: Astacidae
Signs of tent caterpillars in trees	*Malscosoma americanum*

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TABLE 4-3
Sediment and Surface Water Stations by Area

Area	Surface Water Stations	Sediment Stations
East-Background	SW-ED-11	SD-ED-11
East-Offsite Nearfield	SW-ED-13 SW-ED-16	SD-ED-13 SD-ED-14 SD-ED-15 SD-ED-16
East-Offsite Farfield	ROT-1 (IEPA Data for Lake Hillsboro)	Not sampled
West-Background Drainage to South of Site	SW-WD-10	SD-WD-10
West-Background Drainage to West of Site	SW-WD-11	SD-WD-5
West-Offsite Nearfield	SW-WD-6 SW-WD-6D SW-WD-8 SW-WD-7	SD-WD-6 SD-WD-7 SD-WD-8
West-Offsite Middle Fork Shoal Creek Tributary	SW-WD-12	SD-WD-1 SD-WD-2 SD-WD-3 SD-WD-4

# of samples [illegible] – inadequate

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TABLE 4-4

Ecological Receptors Evaluated in the SLERA and Their Potential Exposure Pathways

Ecological Receptor	Potential Exposure Pathway
Aquatic biota, s~~ediment~~ benthic	Dermal contact and ingestion of sediment, dermal contact and respiratory exposures to surface water
Aquatic biota, pelagic	Ingestion of sediment, dermal contact and respiratory exposures to surface water
Avian and mammalian piscivores	Ingestion of surface water, fish, and shellfish

WBH sed. ingestion?

TABLE 4-5

Ecological Assessment and Measurement Endpoints Used for the Eagle Zinc Site

Ecological Receptor	Assessment Endpoint	Receptor Type	Measurement Endpoints
Aquatic biota, sediment	Reduction in species richness or abundance in benthic communities resulting from toxicity	Benthic community	Comparison of sediment concentrations to sediment quality guidelines
Aquatic biota, pelagic	Reduction in species richness or abundance resulting from toxicity	Aquatic community	Comparison of surface water concentrations to ambient water quality criteria
Aquatic wildlife	Reduction in abundance or production of piscivorous wildlife populations resulting from toxicity	Representative wading birds and fish-eating mammals	Comparison of surface water concentrations to water-based wildlife toxicity thresholds

not clear

survival? Reproduction?

abundance requires wading surveys

TABLE 7-1

Summary of Hazard Quotients Greater than 1[a] for Aquatic Receptors in Surface Water and Sediment, Western Drainage Area

COPEC	Surface Water				Sediment			
	Background South	Background West	Nearfield	Farfield	Background South	Background West	Nearfield	Farfield
Aluminum				2				
Arsenic					3[b]		4[b]	
Cadmium	2		12		2		160	3
Copper					2		20	2
Iron[c]	15		3	26			2	
Lead					2		87	2
Mercury							7	
Zinc	58		457	19	8[b]	3	192[b]	12[b]

[a] Based on comparison with Ontario LEL values (Persaud *et al.* 1993).
[b] Based on estimated sediment concentration (J flag).
[c] Iron criteria are only available for dissolved iron, and data are for total iron. Iron flocculates when >1 mg/l, so this value was used for the screening level.

TABLE 7-2
Summary of Hazard Quotients Greater than 1 for
Aquatic Receptors in Surface Water and Sediment, Eastern Drainage Area

COPEC	Surface Water			Sediment		
	Background	Nearfield	Farfield	Background	Nearfield	Farfield
Cadmium		4		2	22	
Copper					3	
Lead					3	
Manganese					2	
Nickel		2				
Zinc	28	332		4[a]	92[a]	

[a] Based on estimated sediment concentration (J flag).

TABLE 7-3
Summary of Hazard Quotients Greater than 1 for Piscivores, Western Drainage Area

COPEC	Great Blue Heron				Mink			
	Background South	Background West	Nearfield	Farfield	Background South	Background West	Nearfield	Farfield
Aluminum					8	44		56
Cadmium	6		34		13		78	3
Zinc	44		306	8	4		28	

DRAFT

TABLE 7-4
Summary of Hazard Quotients Greater than 1 for Piscivores, Eastern Drainage Area

What reduce

COPEC	Great Blue Heron			Mink		
	Background	Nearfield	Farfield	Background	Nearfield	Farfield
Aluminum				7	5	
Cadmium		7			16	
Zinc	17	129		2	12	

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TABLE 7-5
Effects of Uncertainty Management on the Outcome of Screening-Level Ecological Risk Assessments

Source of Uncertainty	SLERA Management Approach	Effect on SLERA Results
Analytical Sampling and Data Analysis		
Limited number of samples – biased sampling	Typically, only a limited number of samples are used in ERAs, and very often they are collected in a biased manner (i.e., targeting "hot spots"). This type of sampling often lacks statistical power and does not likely represent the concentrations in the environment in which wildlife exposure occurs.	Overestimate of exposure and risk
Use of maximum concentrations	The use of the maximum detected concentrations overestimates exposure and risk.	Overestimate of exposure and risk
Selection of Constituents of Potential Ecological Concern (COPECs)		
Background concentrations	Chemicals may be identified as COPECs despite the fact that the detected concentrations are less than background concentrations. This occurs because the ERA Process does not permit use of background until Step 3a of the BERA (EPA 2001b).	Overestimate of exposure and risk
Toxicology and Ecotoxicity Screening Values		
Toxicity data	Toxicity data are only available for a limited number of species (most of them laboratory test species) under a strictly defined set of test conditions that deviate from natural conditions (Sample *et al.* 1996; Suter 1996).	Effect on risk estimate unknown
Laboratory toxicity testing	Simplistic extrapolations from laboratory species to wildlife species and testing conditions to field conditions are not likely accurate, and are rarely, if ever, validated against natural conditions (Power 1996; Tannenbaum 2003).	Overestimate of exposure and risk
Adaptation and tolerance	There is little consistency and no quantitative methodology for the consideration of the diminished bioavailability (and, thereby, diminished toxicity) even though this process is well documented (*e.g.*, Alexander and Alexander 1999; Alexander 2000). Similarly, tolerance and adaptation are not considered directly (Millward and Klerks 2002; Grant 2002). inconsistent	Overestimate of exposure and risk
Hazard Quotients (HQs)		
HQs based on maximum concentrations	The SLERA HQ is based on the maximum detected concentrations and the most conservative ecotoxicity screening value available (EPA 1997a).	Overestimate of exposure and risk
Elevated HQs for background concentrations	HQs may exceed a value of 1 for background concentrations of naturally occurring metals (Tannenbaum 2003). This is due to many of the toxicology and ESV uncertainties already discussed. Also, background HQs greater than 1 indicate that indigenous wildlife would have adapted to these COPECs.	Overestimate of exposure and risk
Interpretation of HQs	An HQ less than or equal to a value of 1 indicates that adverse impacts to wildlife are considered unlikely (EPA 2001b). However, there is no clear guidance for interpreting the HQs that exceed a value of 1, except that this point of departure may indicate that adverse effects of some kind may have occurred or may occur in the future.	Overestimate of exposure and risk
HQs for individual used to evaluate risks to populations	HQs are based on the types of impacts that could occur to individuals (i.e., those individuals exposed to maximum concentrations), and they completely fail to address ecological exposure and risk at spatial scale of populations (Tannenbaum 2003; Durda and Preziosi 1999).	Overestimate of exposure and risk
HQs with unrealistic magnitudes	HQs are seen at magnitudes that suggest acute toxicity. Often, conditions at a site document that this is not the case.	Overestimate of exposure and risk

irrelevant to SLERA

not nec. true; impacts could be present

FIGURES

FIGURES

Figure 2-1: Site Boundaries

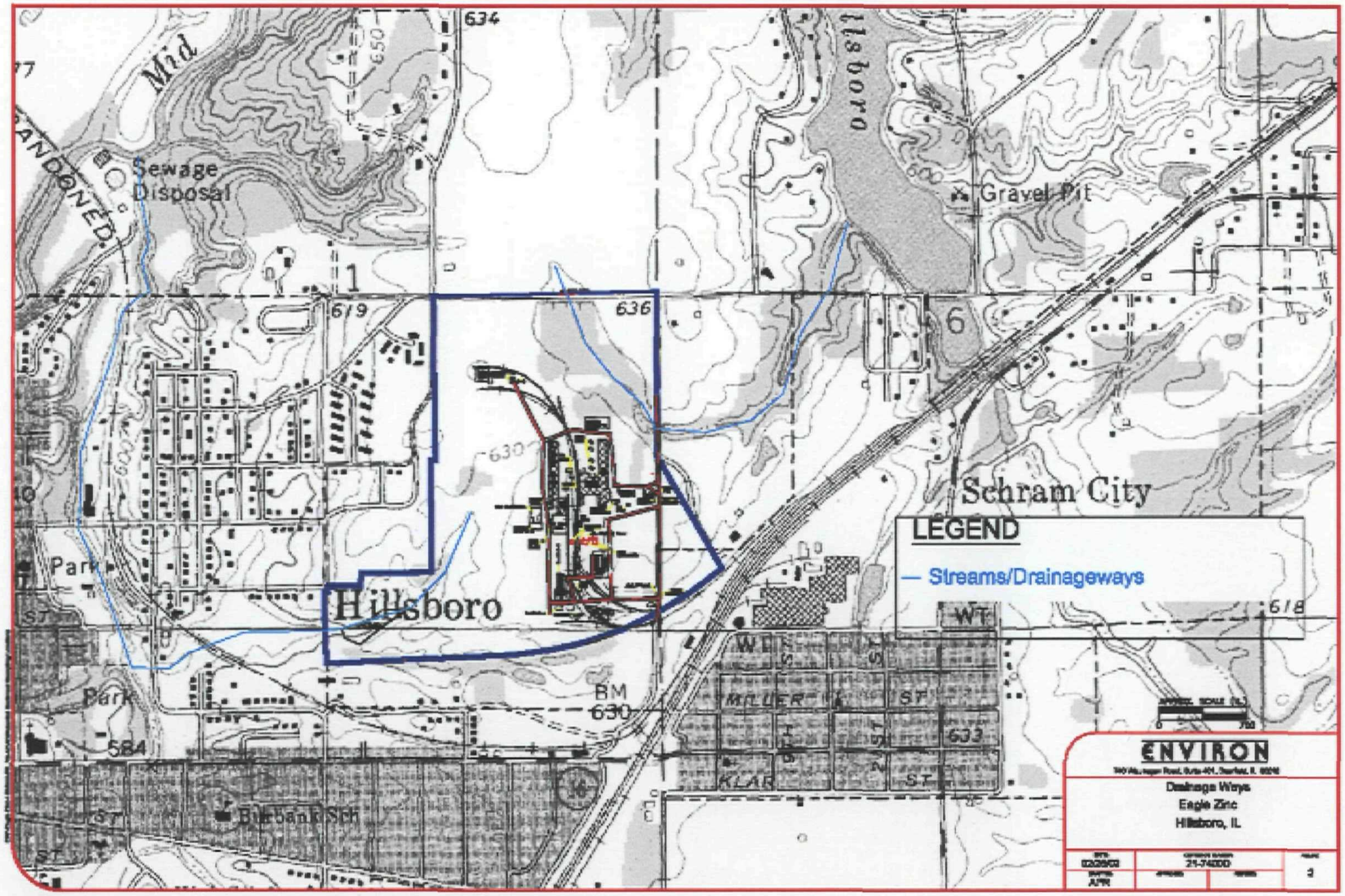


Figure 3-1: Ecological Risk Assessment Framework (U.S. EPA, 1997a)

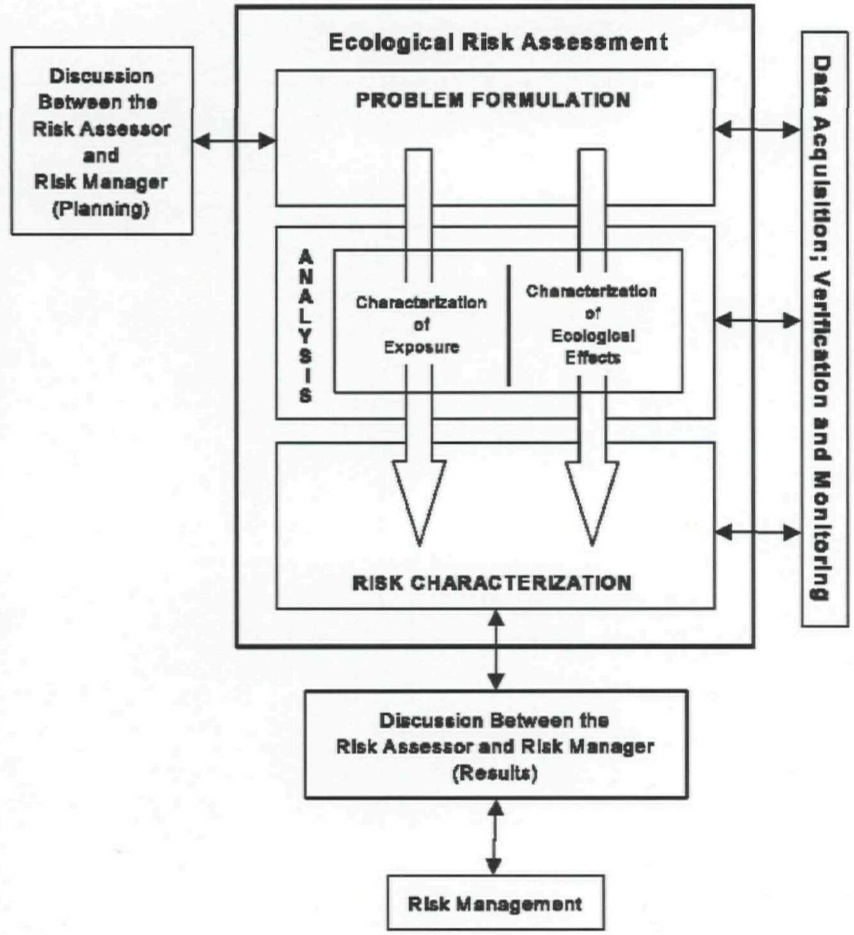
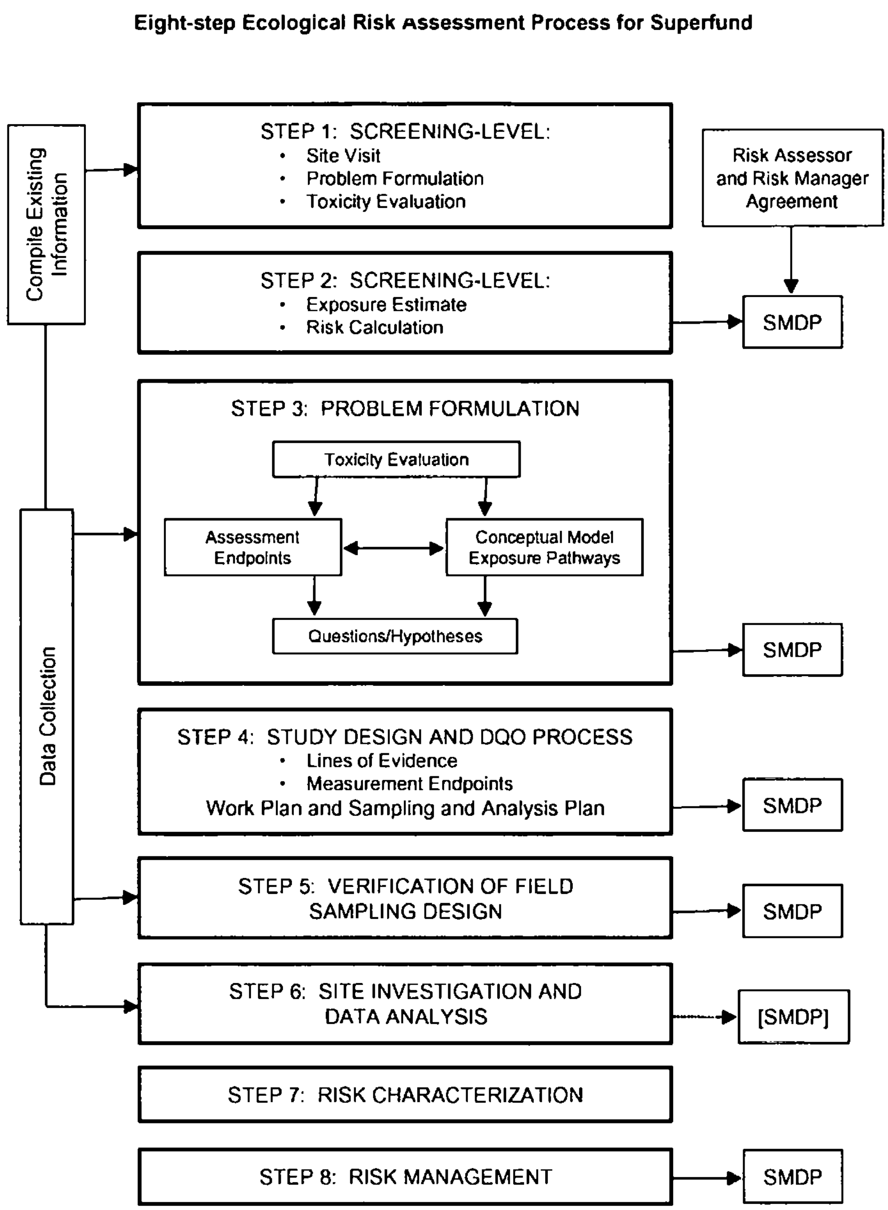
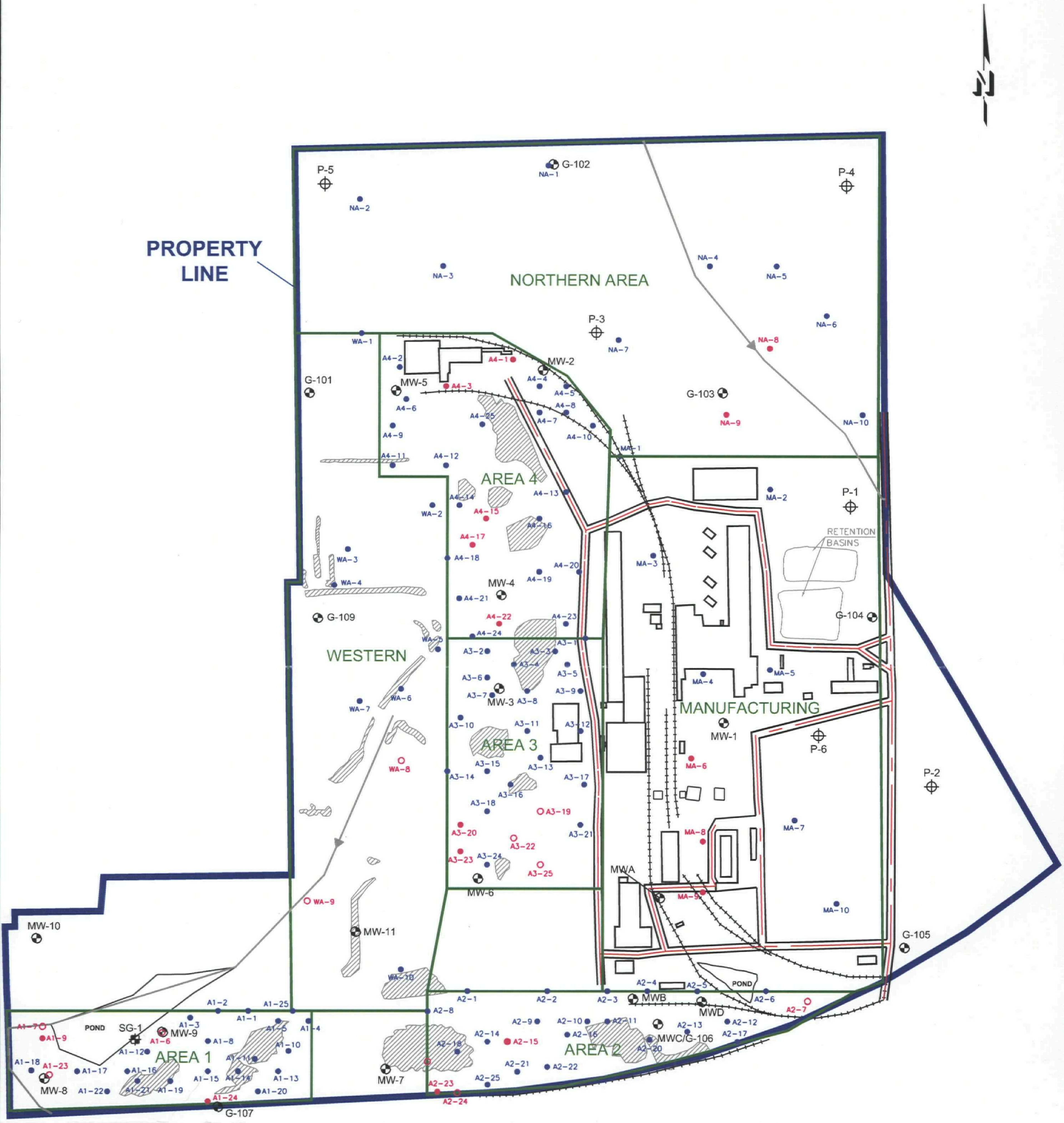


Figure 3-2


Eight-step Ecological Risk Assessment Process for Superfund
Compile Existing Information
STEP 1: SCREENING-LEVEL:
• Site Visit
• Problem Formulation
• Toxicity Evaluation
Risk Assessor and Risk Manager Agreement
STEP 2: SCREENING-LEVEL:
• Exposure Estimate
• Risk Calculation
SMDP
STEP 3: PROBLEM FORMULATION
Toxicity Evaluation
Assessment Endpoints
Conceptual Model Exposure Pathways
Questions/Hypotheses
SMDP
Data Collection
STEP 4: STUDY DESIGN AND DQO PROCESS
• Lines of Evidence
• Measurement Endpoints
Work Plan and Sampling and Analysis Plan
SMDP
STEP 5: VERIFICATION OF FIELD SAMPLING DESIGN
SMDP
STEP 6: SITE INVESTIGATION AND DATA ANALYSIS
[SMDP]
STEP 7: RISK CHARACTERIZATION
STEP 8: RISK MANAGEMENT
SMDP



LEGEND

- SOIL BORING - SAMPLE NOT SENT TO LAB
- SOIL BORING - SAMPLE SENT TO LAB / NO EXCEEDANCE
- SOIL BORING - SAMPLE SENT TO LAB / EXCEEDANCE(S)
- RESIDUE PILES
- MONITORING WELL
- PIEZOMETER
- STAFF GAUGE
- STORM WATER DRAINAGEWAY

APPROX. SCALE (ft.)
0 320

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ENVIRON

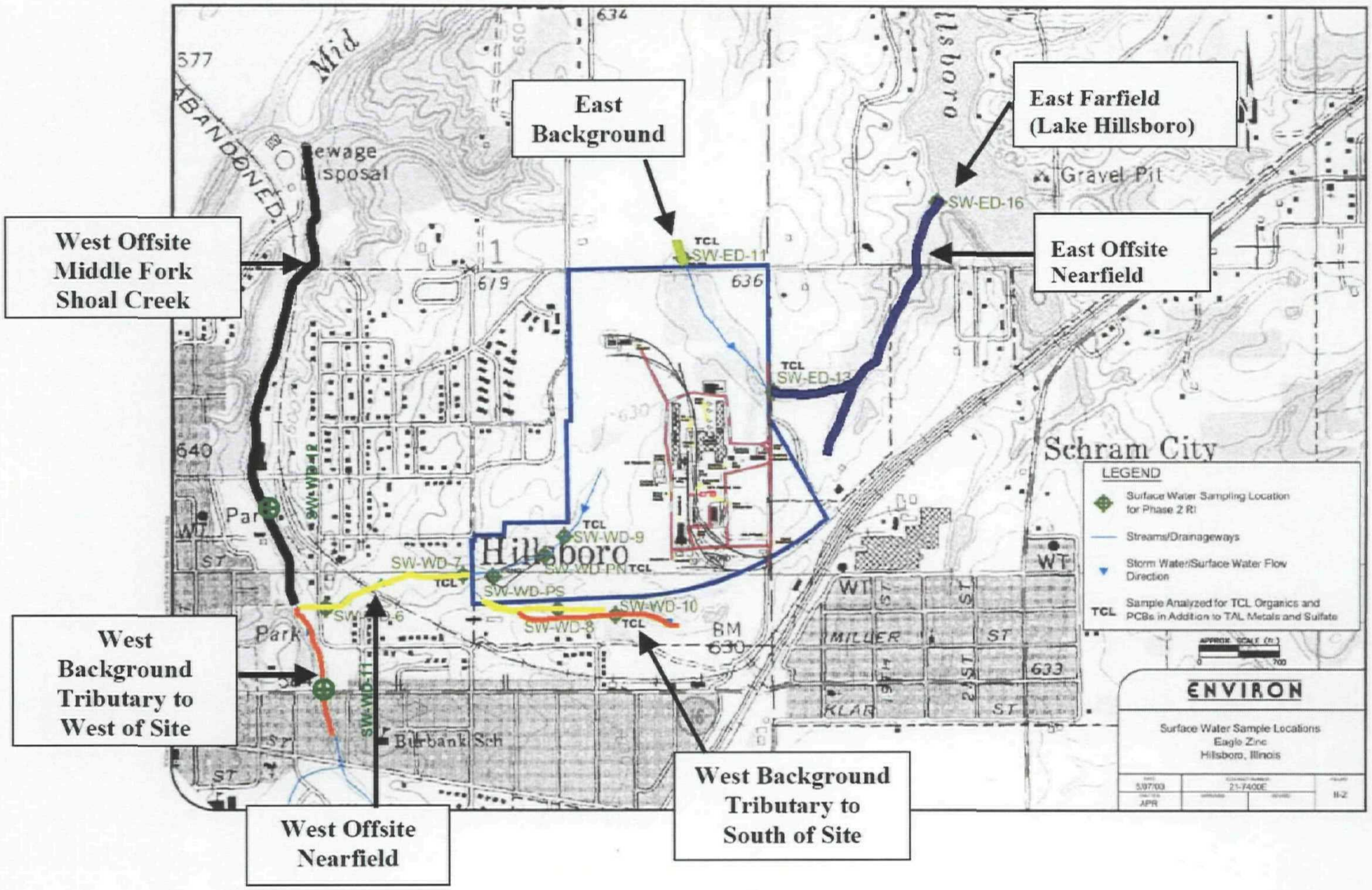
740 Waukegan Road, Suite 401, Deerfield, IL 60015

POTENTIAL AREAS OF CONCERN FOR SOIL
EAGLE ZINC
HILLSBORO, ILLINOIS

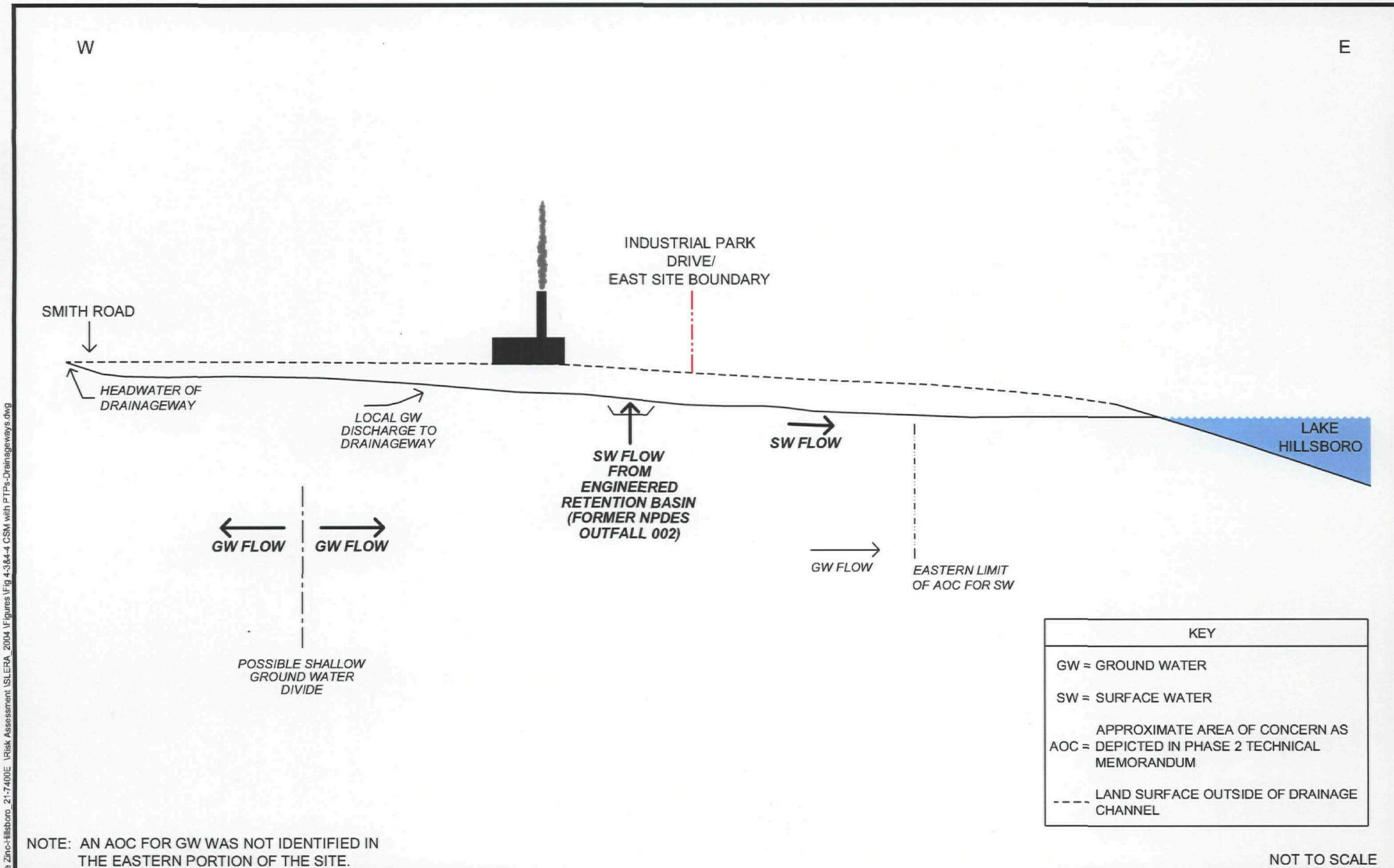
Figure 4-1

Drafter: APR	Date: 3/17/04	Contract Number: 21-7400E	APPROVED:	REVISED:

Figure 4-2: Surface Water Areas*



*Note: locations of SW-WD-11 and SW-WD-12 are approximate



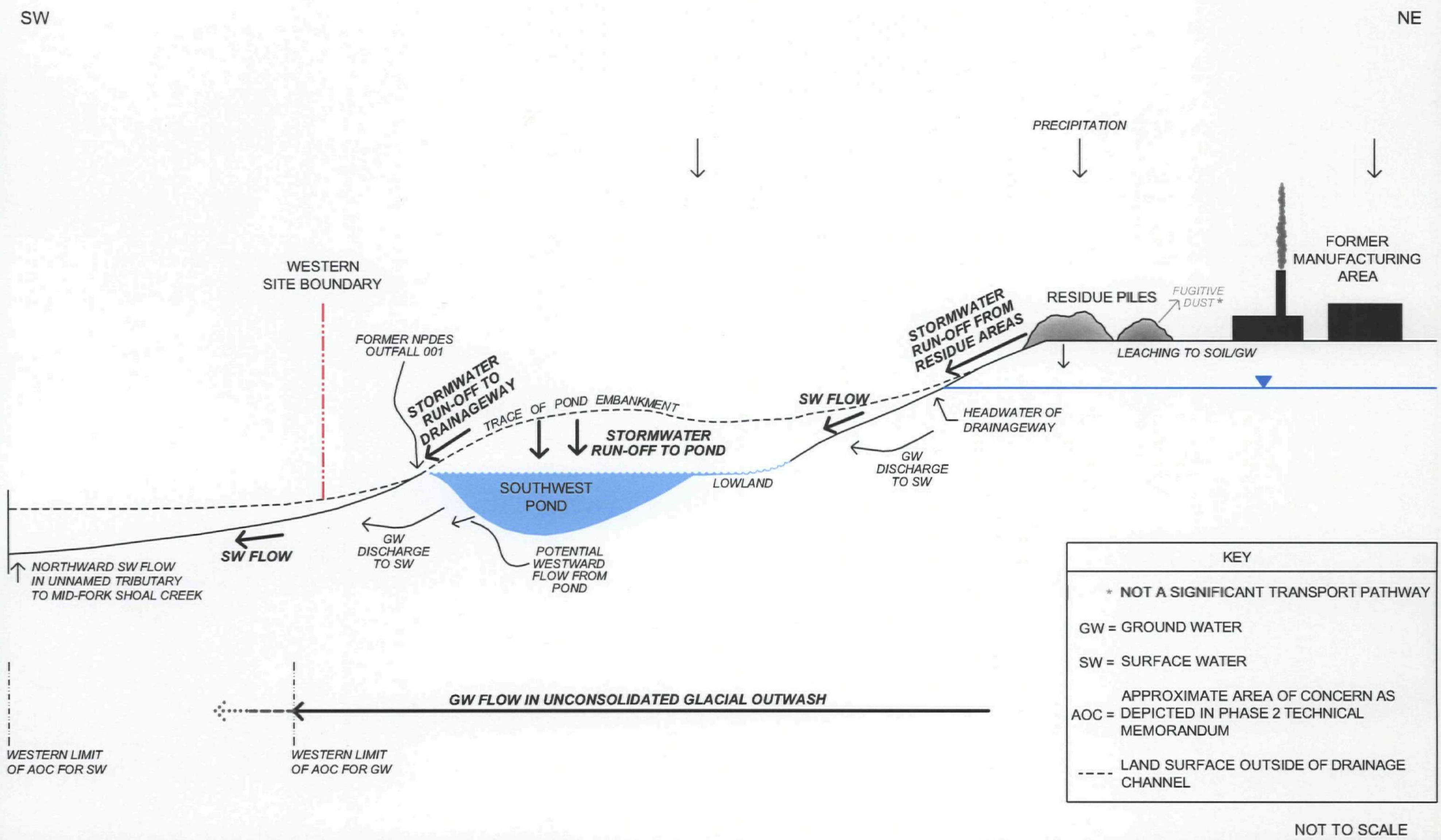
ENVIRON

CONCEPTUAL SITE MODEL WITH POTENTIAL TRANSPORT PATHWAYS:
EASTERN DRAINAGEWAY
EAGLE ZINC
HILLSBORO, ILLINOIS

Figure 4-3

Drafter: APR | Date: 3/17/04 | Contract Number: 21-7400E | Approved: | Revised:

R:\Client Project Files \Eagle Zinc-Hillsboro_21-7400E \Risk Assessment \SLERA_2004 \Figures \Fig 4-3&4-4 CSM with PTPs-Drainageways.dwg



ENVIRON

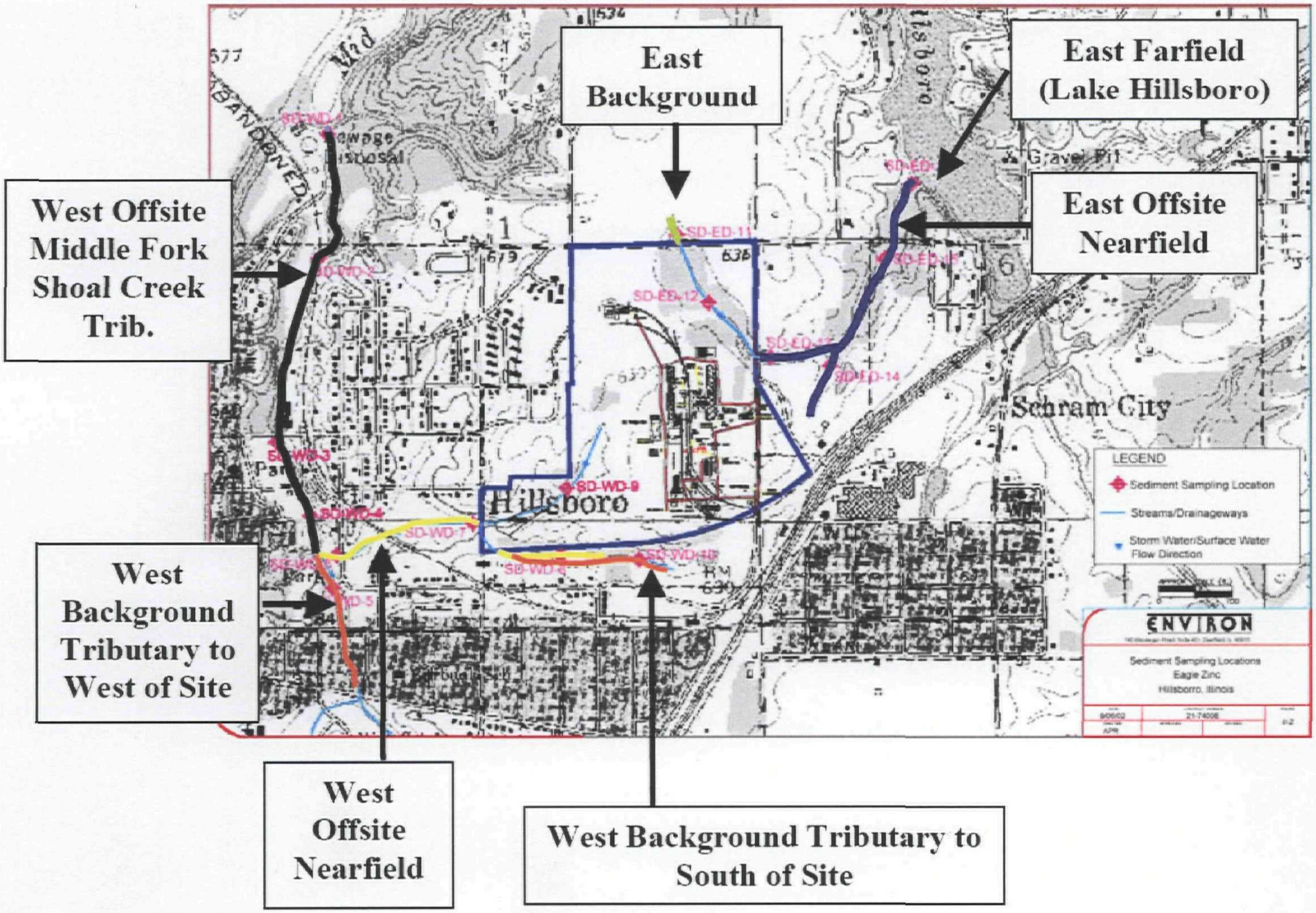
CONCEPTUAL SITE MODEL WITH POTENTIAL TRANSPORT PATHWAYS:
WESTERN DRAINAGEWAY
EAGLE ZINC
HILLSBORO, ILLINOIS

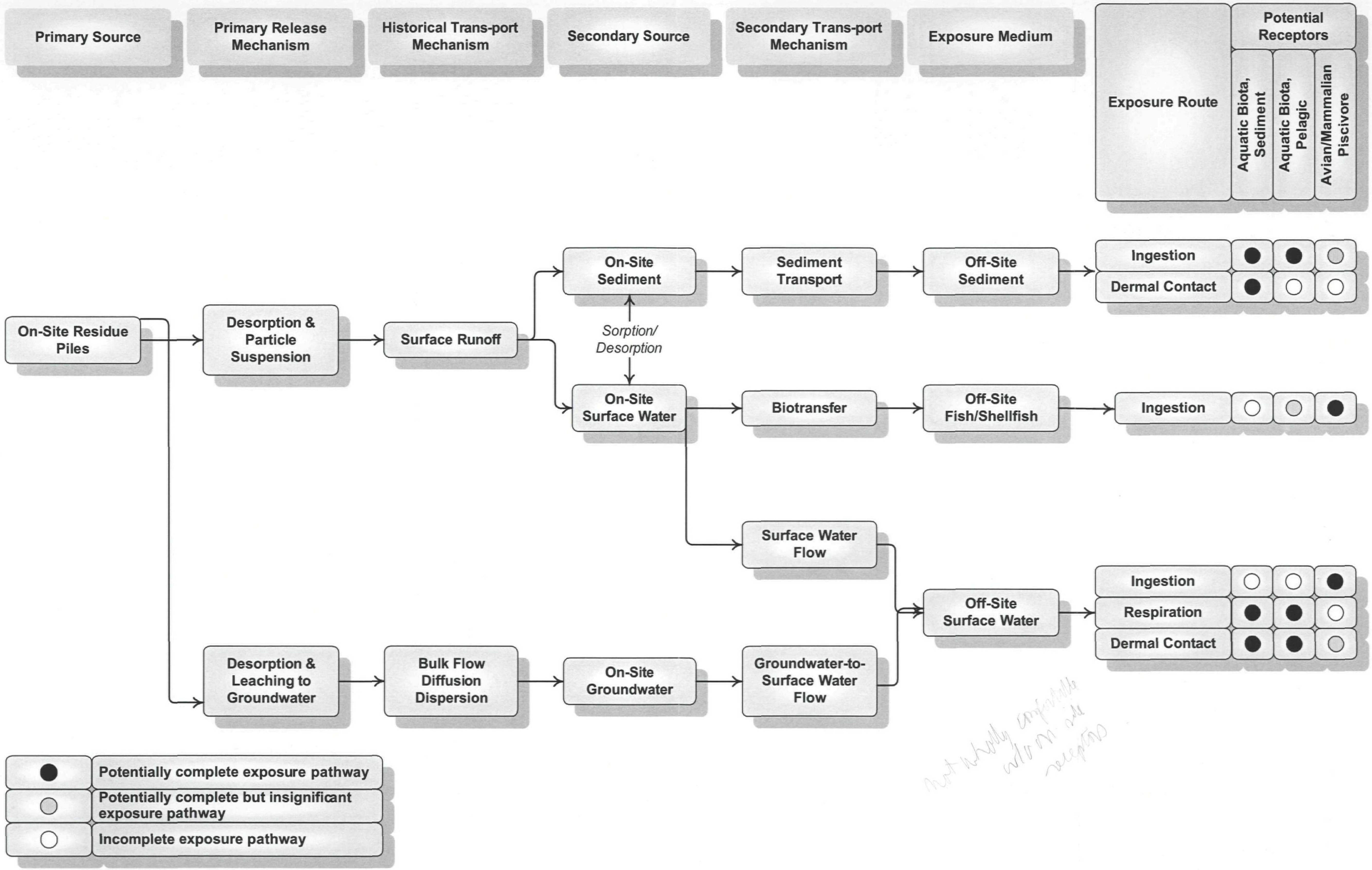
Figure 4-4

Drafter: APR | Date: 3/17/04 | Contract Number: 21-7400E | Approved: | Revised:

R:\Client Project Files \Eagle Zinc-Hillsboro 21-7400E \Risk Assessment \SLERA 2004 \Figures \Fig 4-3&4-4 CSM with PTPs-Drainageways.dwg

Figure 4-5: Sediment Areas





not wholly comfortable w/ on site receptors

Figure 4-6
Exposure Pathway Conceptual Site Model for Ecological Receptors
Eagle Zinc Company Site
Hillsboro, Illinois

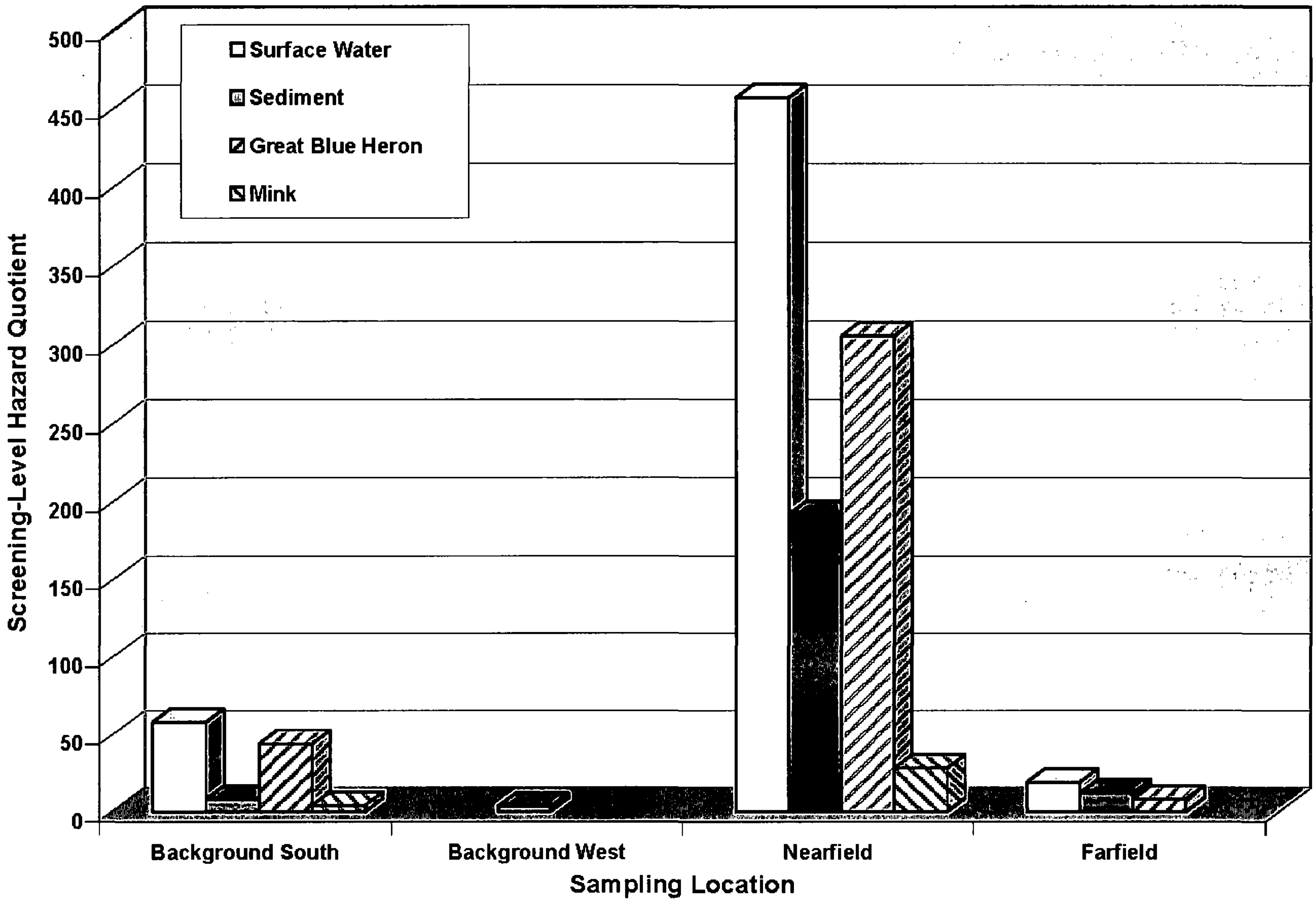


Figure 7-1. Hazard Quotients for Zinc in Surface Water and Sediment, Western Drainage Area

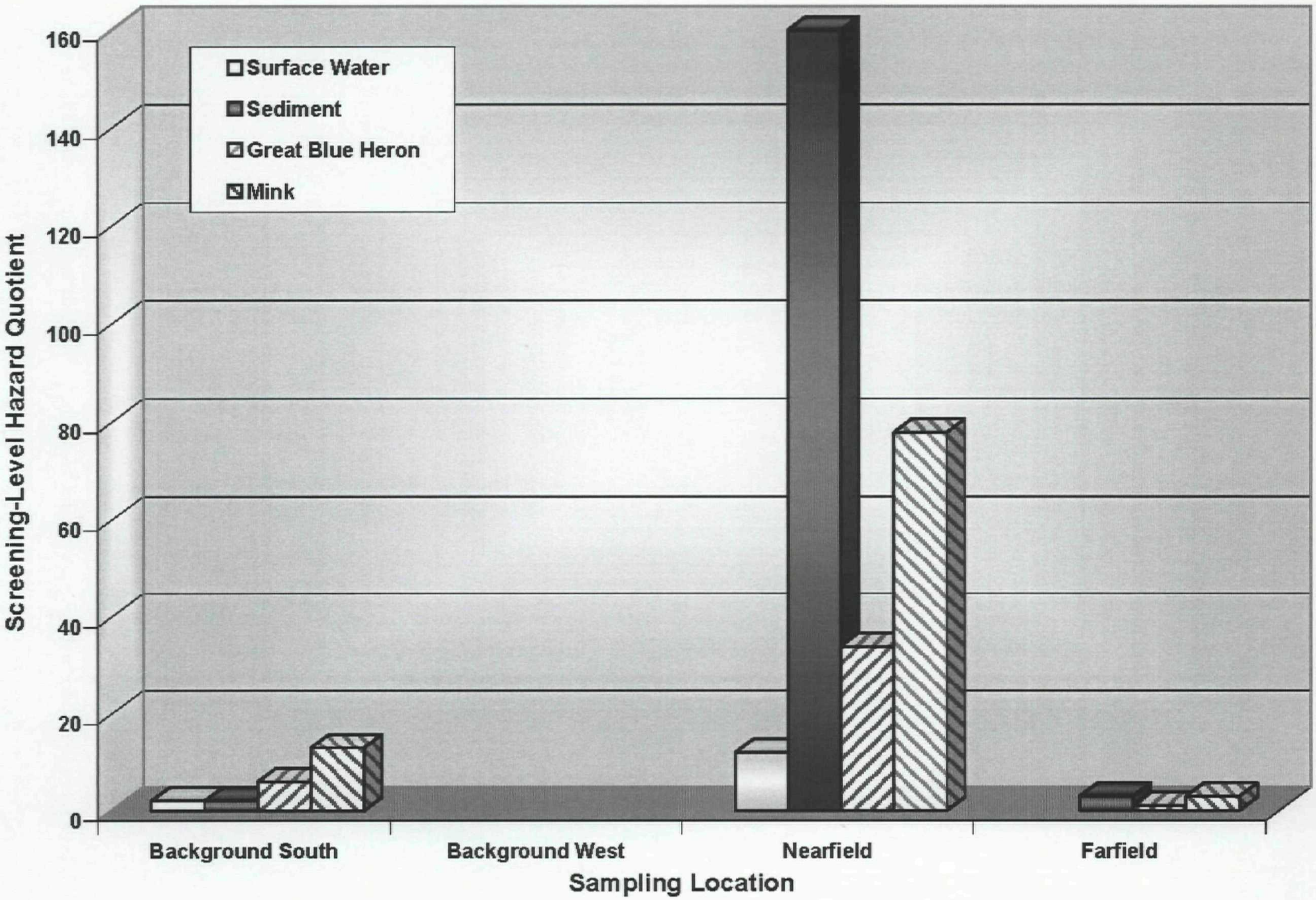


Figure 7-2. Hazard Quotients for Cadmium in Surface Water and Sediment, Western Drainage Area

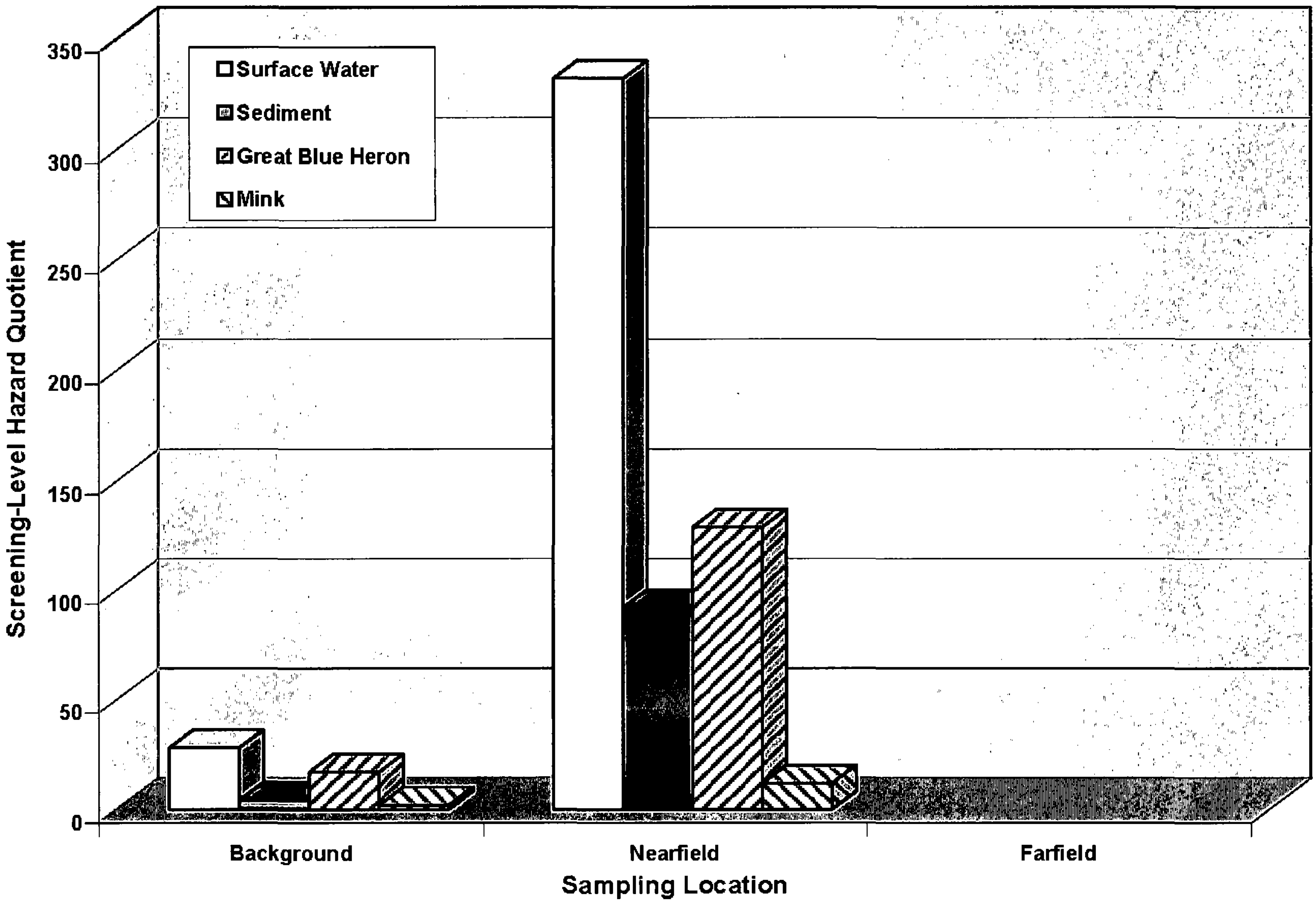


Figure 7-3. Hazard Quotients for Zinc in Surface Water and Sediment, Eastern Drainage Area

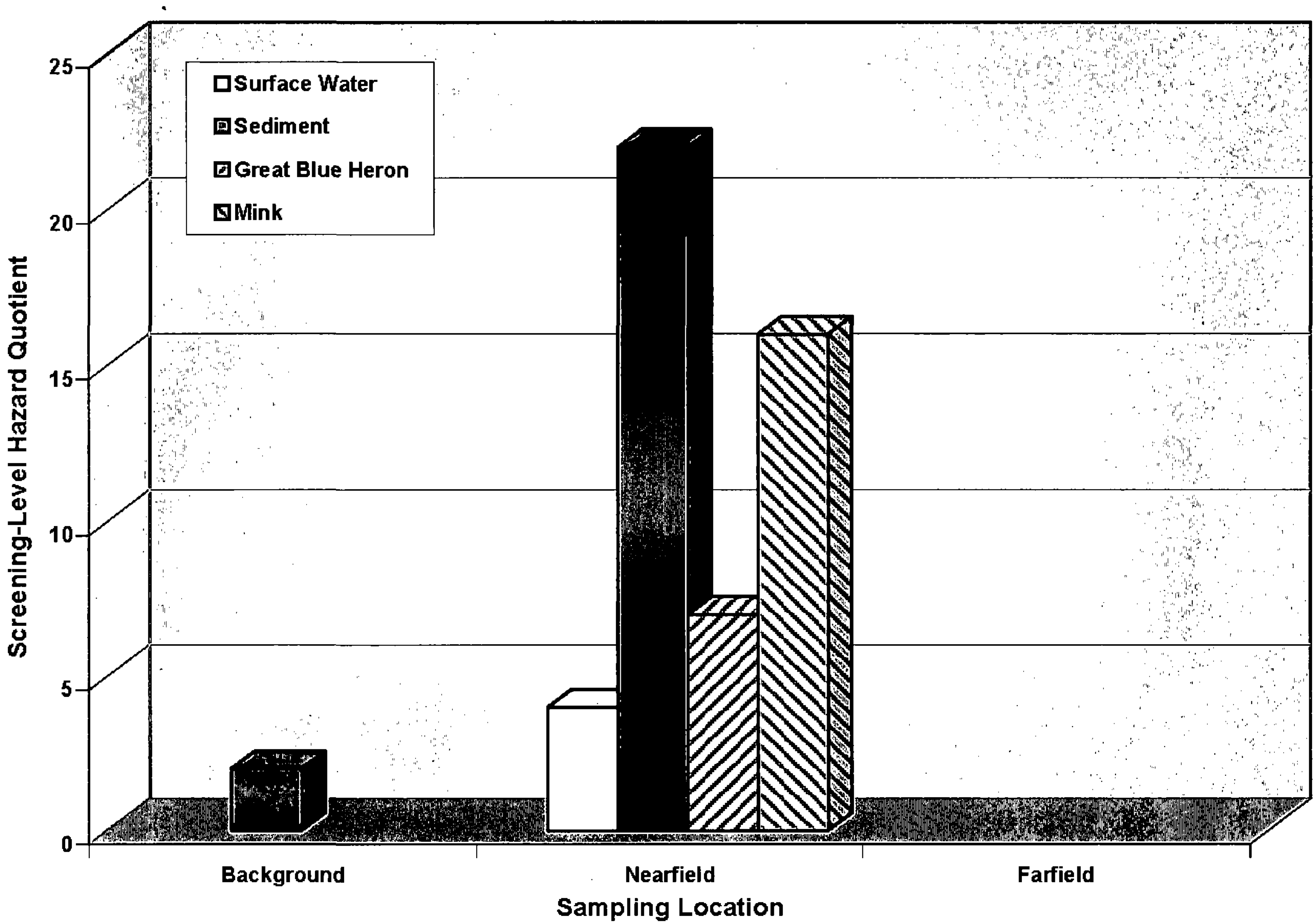


Figure 7-4. Hazard Quotients for Cadmium in Surface Water and Sediment, Eastern Drainage Area

Appendix A:
Ready for Reuse Guidance

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Waste Control & Cleanup

Brownfields
Agency Issues Guidance on Preparing, Using 'Ready-for-Reuse' Determinations

As part of the federal government's effort to return contaminated sites to productive use, the Environmental Protection Agency has issued guidance on when and how to prepare "ready-for-reuse" determinations for superfund sites.

The guidance, which was issued jointly by the Office of Superfund Remediation and Technology Innovation and the Office of Site Remediation Enforcement, is intended to assist EPA headquarters and regional staff members in deciding when these reuse determinations are appropriate for sites or portions of sites.

According to the document, *Guidance for Preparing Superfund Ready-for-Reuse Determinations*, a ready-for-reuse determination is an "environmental status report that documents a technical determination by EPA, in consultation with states, tribes, and local governments, that all or a portion of a superfund site can support specified types of uses and remain protective of human health and the environment."

The determinations were developed under EPA's Land Revitalization Initiative as a means of informing the real estate marketplace about the environmental status of superfund sites to facilitate their sale and reuse, according to the agency.

According to an EPA fact sheet, ready-for-reuse determinations can be issued for sites already on the superfund National Priorities List, "non-time critical removal action sites," and "Superfund Alternative sites."

Only a handful of sites have so far been labeled ready for reuse under the program. The first superfund site so designated, in July 2003, was the Tex Tin Corp. copper smelter site in Texas City, Texas.

Liability Not Addressed

The determinations are intended to complement other cleanup decisions or designations, such as "construction complete" and deletion from the National Priorities List, and "cannot be used in any way to address [superfund] enforcement, liability, or other legal matters," according to the agency.

The determinations are not mandatory for redevelopment activities at a site, but "may help facilitate" reuse activities at certain sites, the guide said.

In some instances, EPA said, sites have been difficult to market and return to productive use when they are deemed superfund sites. In some cases, information about the contamination at the site or the status of its cleanup is not available to developers, or information is difficult for the real estate marketplace to interpret, according to EPA.

The agency hopes the ready-for-reuse determinations will communicate to developers and other potential buyers that the sites are safe to use and facilitate redevelopment. The determinations assure buyers the sites will remain protective of human health and the environment as long as all required response conditions and use limitations identified in the site's response decision documents and land title documents continue to be met, EPA said.

The guidance, which was sent to EPA regional offices Feb. 12, will assist those officials in determining what information is sufficient to support the decision to grant a determination and how to document the determination. Ready-for-reuse determinations should communicate the cleanup status of the site and provide a summary of EPA's knowledge about the environmental conditions of the site as of a specified date, according to the guidance.

The document states that EPA will not maintain an active monitoring program to review the continuing accuracy of ready-for-reuse determinations, but will evaluate the situation when a five-year review is conducted at a superfund site.

The guidance document, Guidance for Preparing Superfund Ready for Reuse Determinations, is available at http://www.epa.gov/superfund/programs/recycle/rfr.htm on the World Wide Web.

By Meredith Preston

ISSN 1521-9410

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | OSWER # 9365.0-33-FS Date: February 12, 2004

EPA

SUPERFUND READY FOR REUSE DETERMINATION GUIDANCE
Fact Sheet

Where can I obtain a copy of EPA's Superfund Ready for Reuse (RfR) Determination Guidance?

EPA's guidance entitled "*Guidance for Preparing Superfund Ready for Reuse Determinations*" is available at www.epa.gov/superfund/programs/recycle/rfrguidance.pdf. The transmittal memo for the guidance is available at www.epa.gov/superfund/programs/recycle/rfrmemo.pdf.

What is a RfR determination and what is its purpose?

The RfR determination is an environmental status report that documents a technical determination by EPA, in consultation with States, Tribes, and local governments, that all or a portion of a real estate property can support specified types of uses and remain protective of human health and the environment. The RfR determination is intended to aid the real estate marketplace by making an affirmative statement, written in plain English and accompanied by supporting decision documentation, that a site identified as *ready for reuse* will remain protective as long as all required response conditions and use limitations identified in the site's response decision documents and land title documents continue to be met.

Do RfR determinations address CERCLA liability?

No. RfR determinations are limited to technical matters and reflect only the environmental status of property, not the activities taken by individuals. Therefore, RfR determinations do not provide any legal rights or legaliy enforceable commitments, and do not include any statements about EPA's enforcement intentions or any party's potential liability regarding a specific site.

What properties are eligible for RfR determinations?

RfR determinations can be issued for proposed and final NPL sites, non-time critical removal action sites, and Superfund Alternative sites.

Is a RfR determination necessary before a site can be reused?

No. Although RfR determinations may help facilitate reuse activities at certain sites, the majority of sites will not be expected to have RfR determinations because RfR determinations are not necessary to support site reuse. However, in certain circumstances, RfR determinations may have considerable value as a tool that provides information to the marketplace. EPA Regions have discretion in deciding whether to issue RfR determinations. If an individual requests a RfR determination, EPA Regions should balance the potential value of a RfR determination in

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The policies and procedures set forth herein are intended as guidance to Agency and other government employees. They do not constitute rule making by the Agency, and may not be relied on to create a substantive or procedural right enforceable by any other person. The Government may take action that is at variance with the policies and procedures in this fact sheet.

supporting site reuse with the work involved, considering other program priorities and the availability of resources.

What is the appropriate timing for issuing RfR determinations?

RfR determinations are intended to help site owners understand that the contamination on the property has been addressed and the property is ready for reuse. However, EPA will not issue a RfR determination until:

- the site meets CERCLA standards of protectiveness and EPA is not aware of any potential circumstances or any EPA, state, or local government environmental restrictions that would make the site conditions not protective for the types of uses addressed in the RfR determination;
- a ROD or other response decision document has been issued giving the public notice of the exposure pathways and risks evaluated for the site;
- after institutional controls required by the ROD or other decision documents have been implemented; and
- after consultation with affected state, tribal, and local governments.

A few limited exceptions to these principles exist. Please see the guidance for details.

Can RfR determinations prohibit uses of property?

No. A RfR determination does not prohibit or prescribe specific uses of property; instead, it states that EPA has determined that a site's conditions, including restrictions, are protective for specific types of uses. The actual selection and determination of the specific land use for a site remains within the jurisdiction of the local government, and RfR determinations should be consistent with and not supercede such decisions.

How can I get more information about Superfund Ready for Reuse determinations?

For questions regarding a Ready for Reuse determination for a specific site, interested parties should contact the site's Remedial Project Manager in the appropriate EPA Regional Office (www.epa.gov). For questions about the implementation of the guidance and EPA's Superfund Redevelopment Initiative, please contact Melissa Friedland at friedland.melissa@epa.gov or (703) 603-8864. Further information about the initial RfR determinations already completed is available at http://www.epa.gov/superfund/programs/recycle/reuse/index.htm.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB 12 2004

OSWER 9365.0-33

MEMORANDUM

SUBJECT: Guidance for Preparing Superfund Ready for Reuse Determinations

FROM: Michael B. Cook, Director
Office of Superfund Remediation and Technology Innovation

Susan E. Bromm, Director
Office of Site Remediation Enforcement

TO: Superfund National Policy Managers, Regions I - X
Director, Office of Environmental Stewardship, Region I
Director, Environmental Accountability Division, Region IV
Regional Counsel, Regions II, III, V, VI, VII, IX, and X
Assistant Regional Administrator, Office of Enforcement, Compliance, and Environmental Justice, Region VIII

Purpose

This memorandum transmits guidance to Regional and Headquarters staff on the preparation and use of Ready for Reuse (RfR) Determinations for Superfund sites. The RfR determination is an environmental status report that documents a technical determination by EPA, in consultation with States, Tribes, and local governments, that all or a portion of a Superfund site can support specified types of uses and remain protective of human health and the environment.

Background

The RfR determination has been developed by EPA as a means of informing the real estate marketplace about the environmental status of Superfund sites in order to facilitate their reuse. Through an RfR determination, EPA makes an affirmative statement, accompanied by supporting decision documentation, that a site identified as "ready for reuse" will remain protective of human health and the environment as long as all required response conditions and use limitations identified in the site's response decision documents and land title documents continue to be met. EPA also intends to develop One Cleanup Program RfR determination procedures to ensure a consistent application of RfR determinations across cleanup programs and to distinguish RfR determinations from other cleanup determinations.

This guidance has been extensively reviewed within EPA and has also benefitted from comments from selected outside parties, such as the Association of State and Territorial Solid Waste Management Officials. In addition, while Headquarters was developing the general approaches and procedures to be used for the Superfund RfR determination process, Headquarters, Regional staffs and stakeholders at select Superfund sites concurrently worked together to complete several initial RfR determinations for those sites. These initial RfR determinations have now been issued. The lessons learned from these efforts inform the provisions of this guidance and have helped to shape the final result. One such lesson is that Headquarters and Regions should continue to work together to find ways to simplify the task of producing RfR determinations and to minimize the burden placed on the resources available to Regions. Headquarters is ready to make the experience it has gained in this effort available to Regions that have not yet prepared RfR determinations. Regions wanting to complete RfR determinations are encouraged to request assistance.

In certain instances, Regions should obtain the concurrence of Office of Site Remediation Enforcement (OSRE) prior to signing RfR determinations. These instances include: the first RfR determination by the Region after the issuance of this Guidance; RfR determinations that substantively deviate from the provisions or model language contained in this Guidance; and RfR determinations at sites where required institutional controls have not been fully implemented. In such instances, OSRE's concurrence role is delegated to the Director of OSRE's Policy and Program Evaluation Division. OSRE commits to respond to Regional requests for concurrence within 2 weeks of receipt of such requests.

Implementation

The guidance applies to proposed and final NPL sites, Superfund Alternative sites and non-time-critical removal action sites. Although Federal facilities have certain statutory requirements to transfer property, site managers at Federal facilities may use this guidance if they find it appropriate. While RfR determinations could be appropriate for groundwater or surface waters in the future, the attached guidance only addresses the reuse of land.

The issuance of RfR determinations is not mandatory. EPA Regions have discretion in deciding whether to issue an RfR determination, and should balance the potential value of an RfR determination in supporting site reuse with the work involved, considering other program priorities and the availability of resources.

Questions about the implementation of this Guidance related to Superfund response activities should be addressed to Melissa Friedland at friedland.melissa@epa.gov, (703) 603-8864. Questions related to enforcement and liability issues should be addressed to Matthew Sander at sander.matthew@epa.gov, (202) 564-7233. Information can also be obtained through Superfund's website as follows:

Guidance: http://www.epa.gov/superfund/programs/recycle/rfrguidance.pdf
Fact Sheet: http://www.epa.gov/superfund/programs/recycle/rfrfactsheet.pdf
Initial RfR determinations: http://www.epa.gov/superfund/programs/recycle/reuse/index.htm
Transmittal memo: http://www.epa.gov/superfund/programs/recycle/transmemo.pdf

Attachment

cc: Nancy Riveland, Superfund Lead Region Coordinator, USEPA Region 9
Jeff Josephson
NARPM Co-Chairs
Joanna Gibson, OSRTI Documents Ccoordiinator
OSRTI Managers
Debbie Dietrich, OEPPR
Linda Garczynski, OBCR
Cliff Rothenstein, OUST
Robert Springer, OSW
Jim Woolford, FFRRO
Ramona Trovato, Senior Advisor to OSWER AA
David Kling, FFEO
Paul Connor, OSRE
Karin Koslow, OSRE
John Michaud, OGC
Earl Salo, OGC
Karen Dworkin, DOJ
Gary King, ASTSWMO

Guidance for Preparing Superfund Ready for Reuse Determinations

I. Introduction

Overview

The U.S. Environmental Protection Agency (EPA) has developed a new document called a Ready for Reuse (RfR) determination that EPA may use to communicate that all or a portion of a Superfund site is protective for specified types of uses.[1] RfR determinations are intended to provide helpful information to the real estate marketplace about the environmental status of Superfund sites to facilitate their reuse. RfR determinations are technical documents that do not provide any legal rights or legally enforceable commitments, and do not include any statements about EPA's enforcement intentions or any party's potential liability regarding a specific site. The issuance of RfR determinations is not mandatory – EPA Regions have discretion in deciding whether to issue RfR determinations, and should balance the potential value of a RfR determination in supporting site reuse with the work involved, considering other program priorities and the availability of resources.

Purpose

The purpose of this guidance is to provide information to EPA Regional and Headquarters staff on the use and preparation of RfR determinations at Superfund sites. When EPA decides to prepare a RfR determination to facilitate reuse, this guidance will assist the Region in determining what information is sufficient to support the RfR decision and how to document the RfR determination. Attachments 1 and 2 to this guidance provide an outline and model language, respectively, to use when preparing RfR determinations.

This guidance is not a regulation itself, nor does it change or substitute for any regulations. Thus, it does not impose legally binding requirements on EPA, States, or the regulated community. This guidance does not confer legal rights or impose legal obligations upon any member of the public. Interested parties are free to raise questions and objections about the substance of this guidance and the appropriateness of the application of this guidance in a particular situation. EPA and other decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from those described in this guidance or not to issue a RfR determination at a particular site. Readers please note that the use of the word "should" in this document means that something is suggested or recommended, but not required.

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[1] As part of its Land Revitalization Agenda, EPA has adopted the Ready for Reuse (RfR) determination as a tool for facilitating reuse of cleaned up sites. EPA also intends to develop One Cleanup Program RfR determination procedures to ensure a consistent application of RfR determinations across cleanup programs and to distinguish RfR determinations from other cleanup determinations. For additional information about EPA's Land Revitalization Agenda, please see www.epa.gov/swerrims/landrevitalization. EPA issued its first Superfund RfR determination at the Tex Tin Superfund site, Operable Unit No. 2, on July 1, 2003, a copy of which can be viewed at http://www.epa.gov/superfund/programs/recycle/reuse/index.htm.

Background

In some instances, Superfund sites have been difficult to market and return to productive reuse. In some cases information about the sites is lacking; while in others the available information is difficult for the real estate marketplace to interpret. Many properties that now present low environmental risks are stigmatized because they are or were part of Superfund sites. The RfR determination is intended to aid the real estate marketplace by making an affirmative statement that a site identified as "ready for reuse" will remain protective of human health and the environment, as long as all required response conditions and use limitations identified in the site's response decision documents and land title documents continue to be met. The RfR determination can further aid the real estate marketplace by providing documentation, written in plain English, to support EPA's determination that the site conditions are ready for specified appropriate types of uses. RfR determinations will communicate information that, where appropriate, will support both public (*e.g.*, ecological, recreational, governmental) and private (*e.g.*, industrial, commercial, residential) reuse.

It is in the public's interest to make the best possible information available to the real estate marketplace for these sites for two key reasons. First, it is EPA's mission to protect human health and the environment, which includes protecting future users of sites. By restating decision document requirements in an easily understood fashion for operation and maintenance (O&M) of a response and institutional controls (ICs), RfR determinations can be used to communicate any land use limitations or land use restrictions on the site, helping to ensure that the response remains protective. Second, RfR determinations give the public notice of the status of EPA's cleanups.

Starting in FY 2004, EPA will implement a new Superfund performance measure pursuant to the Government Performance and Results Act (GPRA) that modifies the routine Superfund pipeline process to include an evaluation of whether there are any sites or portions of sites in which the land is ready for reuse. These GPRA-based evaluations are different from and independent of the RfR determinations that are the subject of this guidance. EPA expects to make a GPRA-based *evaluation* at a site at the same time that the response decision documents for the site are prepared. The results of this GPRA-based evaluation will be documented in CERCLIS after completing the "Checklist for Documenting Ready for Reuse Evaluations" (*see* Attachment 3). RfR determinations are related to this new GPRA performance measure only in the sense that EPA Regions have flexibility in deciding whether to turn information used during the GPRA-based evaluation into a stand-alone RfR determination consistent with this guidance. While the ready for reuse evaluation is a necessary activity for meeting the GPRA performance measure, preparing RfR determinations is discretionary.

II. Definition

The RfR determination is an environmental status report that documents a technical determination by EPA, in consultation with States, Tribes, and local governments, that all or a portion of a real estate property can support specified types of uses and remain protective of human health and the environment, based upon the exposure scenarios evaluated for the site.[2] The RfR determination should communicate the cleanup status of the property and provide a summary of EPA's knowledge about the environmental conditions of the site or portion of the site as of a specified date. The RfR determination should also clearly state that the determination that all or a portion of the site is protective for specified types of uses is based upon the

[2] RfR determinations in no way affect CERCLA's requirements that remedies must be protective of human health and the environment and comply with ARARs unless a waiver is justified. (*See* 40 CFR 300.430).

information then in EPA's possession. Thus, the public should be cautioned that the RfR determination is accurate at the time issued, but may not be if the site's conditions change or if new or additional information is discovered regarding the contamination or conditions at the site. See page 6 below for additional discussion of changed circumstances.

The RfR determination does not prohibit any use of property; instead, it states that EPA has determined that the site's conditions, including restrictions, are protective for specified types of uses. The actual selection and determination of the land use for the site remains as a decision within the jurisdiction of the local government. Whether conditions at a site are protective for additional types of uses beyond those specified in the RfR determination may have to be determined by additional evaluations. RfR determinations are intended to complement Superfund cleanup decisions (*e.g.*, deletion, construction completion), and cannot be used in any way to address CERCLA enforcement, liability, or other legal matters[3] and does not replace or substitute for decision documents required by the National Contingency Plan (NCP)[4].

III. Guidance Applicability

RfR determinations can be issued for proposed and final NPL sites, non-time critical removal action sites[5], and Superfund Alternative sites. Although Federal facilities have certain statutory requirements to transfer property (which are further elaborated on in implementing regulations and policy and guidance documents to foster reuse) site managers at Federal facilities may use this guidance if they find it appropriate.[6] While RfR determinations could be appropriate for groundwater or surface waters in the future, this document only addresses the reuse of land.

A RfR determination may be issued for all or a portion of any Superfund site where EPA has sufficient information through assessment and/or response actions to evaluate specific exposure scenarios to determine what is a protective reuse of the site. A RfR determination should not be issued prior to a Record of Decision (ROD) or other response decision document, which gives the public notice of the exposure pathways and risks evaluated for the site. However, when the site investigation leads to the conclusion that a portion of the land that can be segregated is not contaminated and should be removed from the description of the site, a RfR determination may be appropriate.

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[3] Please see www.epa.gov/enforcement/superfund for a link to EPA policies and guidances that address enforcement and liability matters at Superfund sites.

[4] National Contingency Plan, 40 C.F.R. 300.

[5] This Guidance is generally not appropriate for use at time-critical removal sites because typically time-critical removals are carried out to address immediate threats and do not necessarily generate the type or amount of information sufficient to make use determinations, and may not involve public notice or comment.

[6] Examples of other tools that Federal facilities can use to foster reuse of Federal real property may be found in: *EPA Guidance on the Transfer of Federal Property by Deed Before all Necessary Remedial Action has Been Taken Pursuant to CERCLA Section 120(h)(3)*, June 16, 1998. *See* CERCLA §120(h)(3),(4) for Federal Facility specific real property transfer requirements. *See* http://www.epa.gov/swerffrr/documents/earlytrans.htm for EPA's Federal Facilities Restoration and Reuse web site for their guidances and policies. GSA also has certain requirements for the disposition of federal property. *See* www.gsa.gov. The Brooks Air Force Base, San Antonio, Texas had minimal contamination and a RfR determination (signed on July 22, 2002) was used when the property was transferred.

A RfR determination should not be issued at a Superfund site until the specified property meets CERCLA standards of protectiveness. A RfR determination may be issued when the site meets CERCLA standards of protectiveness and EPA is not aware of any potential circumstances or any EPA or state or local government environmental restrictions that would make the site conditions not protective for the specified types of uses. For example, if the Superfund investigation showed no need for a Superfund response action, but identified a leaking underground storage tank with apparent petroleum product, a RfR determination should not be issued unless the tank problem is addressed. A RfR determination may also be issued when property has been remediated and all physical requirements in the response decision documents have been fully implemented (*e.g.*, the site is construction complete and engineering controls and ICs are in place and operating properly) to ensure that the response remains protective.

RfR determinations may be issued either for sites with unrestricted use and exposure or for restricted use sites. The RfR determination should be consistent with the cleanup goals established for the site. If a RfR determination is issued for restricted use site, then it should clearly and precisely specify the types of uses for which the conditions of the property are determined to be protective,[7] and any ongoing activities or obligations that are required (*e.g.*, maintenance of a fence or land use controls) or prohibited (*e.g.*, no digging below 18 inches) in EPA decision documents. The RfR determination creates no rights, duties or obligations. The purpose of the RfR determination is to provide a technical declaration that also clearly identifies the scenarios under which the property is and remains ready for use. All requirements or conditions discussed in RfR determinations should refer to requirements or conditions created in other EPA documents (*e.g.*, a ROD or Consent Decree).

RfR determinations should not be issued in instances where ICs are required by the ROD or other decision documents and have not been implemented. If the ICs have not been implemented, the site may not be protective for the types of uses that would be specified in a RfR determination.

However, there may be limited circumstances where the Region determines that issuing a RfR determination may be appropriate even though all ICs have not been implemented. Specifically, if neither EPA nor the party benefitting from the RfR determination has the authority to implement the ICs or cannot directly influence the party who does, the Region could consider whether all the use limitations required by the ROD, other response decision documents, and land title documents are being met and, therefore, whether it would be appropriate to issue the RfR determination. For example, if a State does not place an enforceable notice in the property deed restricting residential use, then issuance of a RfR determination might serve as a useful information device, similar to an unenforceable deed notice. In such a situation, the RfR determination should declare that, since the required ICs have not yet been fully implemented, the RfR determination remains accurate only as long as all the use limitations required by the ROD, other response decision documents, and land title documents are being met.

RfR determinations do not supersede or modify ICs. Therefore, RfR determinations should be consistent with ICs already in place and with any that will be established.

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[7] Uses should be specified according to the exposure scenarios evaluated in the risk assessment, *e.g.*, specification of "industrial uses" might include only worker and trespasser exposures, but not exposures associated with an on-site day care center. Regions issuing RfR determinations should be prepared to respond to RfR determination recipients' requests for clarification of specific types of uses covered by the RfR determination.

IV. Format and Content of RfR Determinations

RfR determinations consist of two documents: (1) the RfR Determination Cover Sheet, which provides a summary of EPA's determination (including any requirements or restrictions) and the signatures of EPA and, if possible, state or tribal and local government officials; and (2) the RfR Determination Report, which provides detailed information supporting EPA's determination that the site or portion of the site is protective for certain specified types of uses. Attachment 1 provides a detailed outline of the specific elements of these two documents.

To facilitate national consistency, the outline, headings, and model language (*see* Attachment 2) should be used for all RfR determinations. Additional information that supports the RfR determination may be included, if available. For example, when delineating the boundaries of a site, there should be a geographical description of the site or portion of the site addressed by the RfR determination that allows the public and other stakeholders to understand what portions of the site are specifically addressed. Additional information, such as a map showing the site or portion of a site's boundaries, tax map numbers, or latitude/longitude coordinates, should be included if they are readily available.

Each RfR determination should clearly specify the types of uses that a site can support while the response remains protective of human health and the environment, based upon the exposure assumptions evaluated for the site. While EPA decision documents often refer to use categories, such as industrial, commercial, residential, ecological, or recreational, these terms do not have standard definitions, especially in the many zoning laws across the country. Therefore, each RfR determination should, whenever possible, use local land use authority language and definitions and describe the type of uses the site can support, based on the scenarios of the risk assessment.

Although the RfR determination is a technical document, it should be written (in plain English) so that it can be readily understood by community representatives and the real estate marketplace. EPA technical, legal, and other terminology and acronyms should be used sparingly and, where used, be fully explained.

V. Process

Situations When EPA May Issue a RfR Determination

There may be several situations in which EPA may decide to prepare a RfR determination. For example, Regions have the flexibility to turn a GPRA-based evaluation (of whether there are any sites or portions of sites in which the land is ready for reuse) into a stand-alone RfR determination. This would be done by taking the information used as part of the GPRA-based evaluation and preparing the RfR Determination Cover Sheet and RfR Determination Report as outlined in Attachment 1. Alternatively, a RfR determination may be created independently from the GPRA-based evaluations. For example, at some sites there may be no pending decision document necessitating a GPRA-based evaluation, although there may be current interest in developing the property.

In other instances, EPA may receive a request for a RfR determination but have insufficient information upon which to make the determination and not be scheduled to collect the information in the near future. If the landowner is willing to pay for the investigation, the Region may work with the landowner to conduct the investigation as part of the regular NCP process through an administrative order.

Preparing the RfR Determination

Generally, the site manager (usually a Remedial Project Manager or On-Scene Coordinator) will be responsible for preparing the RfR determination. The site manager should consult with the Regional enforcement attorney before preparing the RfR determination to ensure there are not unintended consequences on enforcement actions. The Regional Superfund Division Director, after consulting with the Regional enforcement attorney, is responsible for signing the RfR determination. The views of States, Tribes, and local governments regarding the appropriateness of the RfR determination should be solicited and considered as early in the process as possible. Further, States, Tribes, and local governments should be invited to participate in the development and signature of the RfR determination, although State, Tribal, or local government concurrence is not necessary. The site manager should also coordinate with the landowner and/or the person who requested the RfR determination, if not the landowner.

Public Notice and Access

So long as public notice and comment has occurred in the context of developing the response decision documents supporting the RfR determination, additional notice and comment may not be necessary.

Once EPA signs the RfR determination, the document should be given to the landowner and should be made available in the local repository established for the site, as well as online at the EPA Region's web site and at EPA's Superfund Redevelopment Initiative web site, www.epa.gov/superfund/programs/recycle/.

Monitoring and Revising RfR Determinations

The RfR determination is a technical assessment of the types of uses that a property may support and remain protective of human health and the environment, at a particular time. The public should be cautioned that the RfR determination is accurate at the time it is signed and remains current as long as the conditions and information that formed the basis for the RfR determination remain substantially unchanged. The public should also be made aware that EPA does not expect to maintain an active monitoring program to review the continuing accuracy of RfR determinations. However, when a five-year review is conducted at a site, it should include an evaluation of any RfR determinations that EPA has issued for the site.

If EPA becomes aware, either through a five-year review or other information that changed circumstances or additional information may have rendered a RfR determination inaccurate, EPA may, as appropriate, decide to revise a RfR determination but is under no obligation to do so. A revision may, depending on the circumstances, include a retraction of the original RfR determination. For example but without limitation, EPA may revise a RfR determination if: EPA learns that a site or portion of a site covered by a RfR determination presents a risk to human health or the environment (*e.g.*, revised toxicity factors for contaminants of concern) and might require additional action; EPA discovers new information about a site's conditions that may indicate that the response may no longer be protective; or a party fails to maintain ICs, or to meet its responsibilities regarding a site's required O&M and monitoring actions. Mechanisms are established to maintain engineering controls and ICs should be listed in the RfR determination.

If a Region plans to revise a RfR determination, it is recommended that the Region inform the landowner and any property occupants of the reasons for doing so. Appropriate stakeholders (*i.e.*, state, tribal, local governments) should be notified of a RfR determination revision and a notice should be made available at the local repository established for the site. As with an original RfR determination, the Region may consult with the landowner, any property occupants, and stakeholders regarding the revised RfR determination.

Because the RfR determination addresses a site or portion of a site (and not the owner), a change of ownership does not, by itself, affect the RfR determination. A successor owner might request a new RfR determination, but Regions should generally consider such a request only if there is new or additional information about the environmental status or proposed types of uses of the site. A successor owner typically would obtain a copy of the RfR determination from the prior owner or from the local repository established for the site.

VI. Enforcement Considerations

The scope of RfR determinations is limited to technical matters, focusing on the protective reuse of sites after a response is in place. Thus, RfR determinations should not include any statements about EPA's enforcement intentions or any party's potential liability regarding a specific site. EPA Regions can take a number of steps to ensure that RfR determinations remain distinctly technical and are not misunderstood to be providing legally enforceable commitments or addressing any party's legal rights.

The Regional attorney responsible for enforcement matters at the site should review the RfR determination to ensure that explicit and implicit assurances regarding liability are not provided. RfR determinations should not be used as, nor combined in the same document with, a comfort/status letter or with any document that provides explicit liability/legal assurances. In addition, RfR determinations should avoid references to statutory or regulatory liability or enforcement provisions. For example, RfR determinations should omit any reference to the statutory liability or enforcement provisions provided in the Brownfields Amendments to CERCLA.[8] Such reference in that instance could have the unintended consequence of creating an implicit assurance that a person has taken "reasonable steps" or made "all appropriate inquiry" and thus satisfied one of the conditions for a liability exemption. RfR determinations will not address these issues because they reflect only the environmental status of the property; not activities taken by individuals.

Both the RfR Determination Cover Sheet and the RfR Determination Report should include explicit disclaimers making it clear that the RfR determination addresses technical matters only and that it should not be construed as a statement about EPA's enforcement intentions or that it conveys legal rights (*see* Attachment 2 for model language). In addition, the RfR Determination Cover Sheet should explicitly refer to the attached RfR Determination Report, thus assuring that the RfR determination is fully understood.

EPA should not characterize RfR determinations as "certificates." The term "certificate" connotes a "warranty" and could imply that the RfR determination is extending legal rights to the recipient. In addition, the term "certificate" could easily be confused in the real estate marketplace with a State voluntary cleanup program "certificate" that typically includes a release from liability under State law.

RfR determinations do not supersede or modify local, county, and State land use decisions and requirements and/or title documents, including, but not limited to, easements, restrictions, and ICs. Thus, RfR determinations should be consistent with and not appear to supersede applicable local land use decisions and requirements. RfR determinations are also not a substitute for compliance with the response decision documents as they relate to local land use requirements (*e.g.*, recording deed restrictions). In addition, RfR

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[8] The *Small Business Liability Relief and Brownfields Revitalization Act*, Public Law No. 107-118 (Jan. 11, 2002).

determination should focus on the types of uses that sites will be protective for, rather than determine or suggest that certain uses of property are "allowed" or "disallowed." Such land use decisions remain a local government determination and these are not intended to cross into land use type of decisions.

Regional enforcement attorneys should ensure that the RfR Determination Cover Sheet and RfR Determination Report identify the entity responsible for ensuring that the site remains protective of human health and the environment. This includes identifying the entity responsible for the implementation, maintenance, monitoring, and integrity of ICs required by the response decision documents, even if the ownership of the property is transferred in the future.

Regional enforcement attorneys should ensure that the RfR determination is consistent with any ICs required by the response decision documents.

Finally, as stated above (*see* "Preparing the RfR Determination"), the site manager should consult with the Regional enforcement attorney before preparing the RfR determination to ensure that there are not unintended consequences on enforcement actions. For example, EPA generally should not provide RfR determinations on properties subject to CERCLA liens unless EPA and the property owner have agreed to a plan for resolution.

Attachment 1. Outline for Ready for Reuse Determination Documents

RfR Determination Cover Sheet	Key Elements
RfR Cover Sheet	• Description of the site or portion of the site (be explicit if addressing specific OU) • Purpose (*see* Attachment 2 for model language) • EPA and State/Tribal/Local signatures and date • Applicable local land use regulations • Reference back to RfR Determination Report • Institutional controls and engineering controls • Operation and maintenance and monitoring actions • Entity responsible for ensuring protectiveness of site

RfR Determination Report	Key Elements
Executive Summary	• Description of the site or portion of the site (be explicit if addressing specific OU) • Purpose (*see* Attachment 2 for model language) • EPA signature and date • State/Tribal/Local signatures (optional) • How to obtain relevant documents • EPA and State/Tribal/Local point of contact
Location of Site or Portion of Site	• Geographic descriptors (preferred: maps delineating site boundaries, tax map numbers, latitude/longitude coordinates, survey of land parcel)
Site Summary (brief)	• Site and contaminant history • Summary of cleanup activities • Redevelopment/reuse history • Time line of EPA activities to date (optional)
EPA's Basis for the Determination	• Description of risks associated with specified types of uses, related to risk based action levels (*e.g.*, exposure pathways, contaminants) • List of primary documents used to determine site's suitability for reuse • Inclusion of documents as an appendix
Ongoing Limitations and Responsibilities	• Institutional controls and engineering controls • Operation and maintenance and monitoring actions • Entity responsible for ensuring protectiveness of site • Applicable local land use regulations

Attachment 2. Model Language for RfR Determinations

Model Purpose Language:

This Ready for Reuse Determination provides that EPA has made a technical determination that the [ABC Site] located in [City, County, State] is ready for reuse and will remain protective of human health and the environment, subject to any limitations identified in the ROD, other response decision documents, the land title documents, and below regarding the use of the site and the activities that must be performed to ensure the continued protectiveness of the site:

- *[uses supported, use restrictions]*
- *[summary of required activities, e.g., ICs, O&M, monitoring, etc. and entity responsible for ensuring protectiveness]*

This Ready for Reuse Determination is a technical decision document and does not have any legally binding effect and does not expressly or implicitly create, expand, or limit any legal rights, obligations, responsibilities, expectations, or benefits of any party. EPA assumes no responsibility for reuse activities and/or any potential harm that might result from reuse activities. EPA retains any and all rights and authorities it has, including but not limited to legal, equitable, or administrative rights. EPA specifically retains any and all rights and authorities it has to conduct, direct, oversee, and/or require environmental response actions in connection with the site, including but not limited to instances when new or additional information has been discovered regarding the contamination or conditions at the site that indicates that the response and/or the conditions at the site are no longer protective of human health or the environment for the types of uses identified in the Ready for Reuse determination.

The types of uses identified as protective in this RfR determination remain subject to (i) applicable federal, state, and local regulation, including, but not limited to, zoning ordinances and building codes, and to (ii) title documents, including, but not limited to, easements, restrictions, and institutional controls.

Model Executive Summary Language:

For unrestricted use sites: *In [month, year], EPA [State, Tribe, PRP] conducted an investigation of the site [site or portion of a site, OU]. During that investigation, EPA [State, Tribe, PRP] evaluated [media]. As a result of the investigation, EPA determined in its decision document that Superfund response actions were unnecessary, and is not aware of any potential circumstances or any EPA, State or local government restrictions for this site [site or portion of a site, OU] that would make the site conditions not be protective for the designated land uses in this document.*

For restricted use sites: *During EPA's [State's, Tribe's] investigation in [month, year] of the site [site or portion of a site, OU], EPA [State, Tribe, PRP] performed an assessment of the human and environmental risks associated with using the site for [land use] purposes. The risks that were identified for this site [site or portion of a site, OU] were [human, environmental] exposure to [primary contaminants of concern] through [media]. In its [decision document], EPA selected response actions to [manage, eliminate] these risks to human health and the environment. With the completion of these response actions, EPA [State, Tribe, PRP] has attained the CERCLA cleanup goals and remedial action objectives for the site [site or portion of a site, OU]. As a result, based on information available as of this date, EPA has determined that the unacceptable levels of risk to current and future users of the site have been abated and the site may be used for [type of land use] purposes and will remain protective of human health and the environment.*

Attachment 3. Checklist for Documenting Ready-for-Reuse Evaluations for the Superfund Reuse Performance Measure

SITE NAME:

SITE ADDRESS (street, city, state, zip):

EPA ID:

SITE ID:

1. Indicate the total acres of land on the site that is ready for reuse: ______________
2. The site, or portion of the site, is ready for: ❑ Unrestricted use (i.e., the site or portion of the site can support residential reuse). ❑ Restricted use (i.e., the site, or portion of the site, cannot support residential use). ❑ Both (i.e., a portion of the site can support residential use and another portion of the site cannot support residential use).
3. The site, or portion of the site, is ready for reuse because: ❑ Superfund response actions are unnecessary based on an assessment of the site and EPA is not currently aware of other EPA, state, or local environmental or land use restrictions. ❑ Cleanup goals for the land have been attained.

4. What is the source of information used to support the finding that all or a portion of this site is ready for reuse?

   - ❑ Preliminary Assessment Report
   - ❑ Site Inspection Report
   - ❑ Record of Decision (ROD)
   - ❑ Interim/Final RA Report
   - ❑ Preliminary Close-Out Report
   - ❑ Final OSC Report (for removals)
   - ❑ Notice of Deletion/Partial Deletion
   - ❑ Five-Year Review
   - ❑ Findings of Suitability to Lease (FOSL)
   - ❑ Finding of Suitability to Transfer (FOST)
   - ❑ Finding of Suitability for Early Transfer (FOSET)
   - ❑ Final Ready-for-Reuse Determination

5. What is the source of information used to determine the acreage that is ready for reuse?

   - ❑ Information from an EPA document (e.g., ROD, RI Report)
   - ❑ Official State or Local Government Document
   - ❑ Information from Property Owner
   - ❑ Land Survey
   - ❑ Newspaper/Media Report
   - ❑ Best Professional Judgment
   - ❑ Other *(specify)*: ______________________________

6. Is the entire site or a portion(s) of the site ready for reuse?

   - ❑ Entire Site
   - ❑ Portion(s) of Site

7. Which operable unit(s) contain land that is ready for reuse?
   Please indicate OU number(s): __________________

8. Provide a brief geographic description of the site or portion(s) of the site that is ready for reuse.

Appendix B:
Check Sheet for Ecological Description of Eagle Zinc Site

Check Sheet for Ecological Description of Eagle Zinc Site

Based on July 2002 Site Visit

Setting

1. What are the land uses/facilities in the vicinity of the site?

General area is characterized by intensive land use with many industrial facilities, as follows:

North small facility, Hayes Abrasives; golf course; farm fields

South small commercial/industrial facilities (Univ. of IL Extension office; Fuller Brothers Construction/Ready Mix; Hixson Lumber; Hillsboro Rental; Vogel Plumbing

East Industrial Drive; an asphalt company; a railroad corridor; former Hillsboro Glass Company facility (now a steel warehouse)

West Some undeveloped land and a residential area containing single- and multi-family dwellings

What directions do contaminant gradients follow?

Surface water, sediment, soil: Drainageways drain to southwest and northeast, following site topography (see map)

Ground water: Ground water flows generally follows topography, with flow generally towards the southwest in the western part of the site and towards the east and southeast in the eastern part of the site. Limited radial flow in northward direction.

2. What is the site's highest elevation? 637 feet

What is the site's lowest elevation? 600 feet

3. Is the site readily accessible? __X__Yes _____ No

If No, explain: ____

4. For each pair of descriptors, circle the one that best describes the site.

Wooded/open hilly/flat marshy/dry

Other

5. Does the site contain or drain into surface water? Yes No

Site drains to Lake Hillsboro (to the east) and to a tributary of the Middle Fork Shoal Creek (to the west)

If Yes what type(s)?

Pond or lake: Artificial storm water pond

Location southwest corner of site

Area 1.2 acres

Average Depth (or depth range) unknown

Appendix B: Check Sheet for Ecological Description of Eagle Zinc Site

Pond or lake: Artificial storm water pond

Location southeast portion of site

Area 0.27 acres

Average Depth (or depth range) unknown

Pond or lake: Artificial storm water retention basin

Location eastern portion of site (northern pond)

Area 0.41 acres (when full); surface area of water reduced by approx. 20% at time of site visit

Average Depth (or depth range) less than one foot at time of site visit

Pond or lake: Artificial storm water retention basin

Location eastern portion of site (southern pond)

Area 0.41 acres (when full); surface area of water was reduced by approx. half at time of site visit

Average Depth (or depth range) less than one foot at time of site visit

Stream or River (including intermittent streams): There are two intermittent drainage ditches on the site and two intermittent streams located offsite. These serve as storm water conduits from the site.

Onsite – The intermittent drainage ditch that crosses northeast corner of the site and flows eastward was dry at the time of the site visit.

Location Northeast corner of the site

Length (onsite) is 1,344 feet

Average Width (or width range) Dry at time of site visit

Average Depth (or depth range) Dry at time of site visit

Type(s) of bottom Silty clay

Flow Rate Dry at time of site visit

Onsite – The intermittent drainage ditch that drains the southwest portion of the site and flows west was dry at the time of the site visit.

Location Southwest portion of the site

Length (onsite) is 900 feet

Average Width (or width range) Dry at time of site visit

Average Depth (or depth range) Dry at time of site visit

Type(s) of bottom Silty clay

Flow Rate Dry at time of site visit

Offsite – The intermittent stream that begins at the outfall from the stormwater retention basins and ends at Lake Hillsboro.

Location East of the site

Length 2,724 feet

Average Width (or width range) Mostly dry at time of site visit. Channel width averages 4 feet.

Average Depth (or depth range) Mostly dry at time of site visit. Pools of water observed were approximately

10 inches deep on average.

Type(s) of bottom Silty clay, some rocks

Flow Rate Not flowing at time of visit. Water was observed in pools. Sediments were firmly dry at location of outlet to Lake Hillsboro.

Offsite – The intermittent stream that begins at the western site boundary, downstream from the southwest pond, and which ends at the unnamed tributary to Middle Fork Shoal Creek.

Location West of the site

Length 1,784 feet

Average Width (or width range) Channel width averages 3 feet.

Average Depth (or depth range) < 6 inches

Type(s) of bottom Silty clay, some rocks

Flow Rate Very low flow, almost stagnant

Estuary/embayment: Not applicable

Location ______________________________

Area ______________________________

Average Depth (or depth range) ______________

Type(s) of bottom ______________________

List any known parameters of site-associated surface water: On-site drainageways are ephemeral and were dry at the time of the site visit

PH _____ Temperature______ Dissolved Oxygen______

Total Suspended Solids__________________

Total Organic Carbon __________________

Hardness __________________________

Salinity ____________________________

Other (specify) ______________________

List any known parameters of site-associated surface water: Offsite - The intermittent stream that begins at the outfall from the stormwater retention basins and ends at Lake Hillsboro. Measurements taken from pool of water (stream was mostly dry) ~150 meters downstream of Industrial Drive

PH _____ Temperature 21.5 °C Dissolved Oxygen______

Total Suspended Solids__________________

Total Organic Carbon __________________

Hardness __________________________

Salinity ____________________________

Other (specify) Conductivity 543 μS/cm

List any known parameters of site-associated surface water: Offsite – The intermittent stream that begins at the western site boundary, downstream from the southwest pond, and which ends at the unnamed tributary to Middle Fork Shoal Creek. Measurements taken just downstream of site.

PH ______ Temperature 15.8 °C Dissolved Oxygen_______

Total Suspended Solids_______________________

Total Organic Carbon ________________________

Hardness __________________________________

Salinity ____________________________________

Other (specify) Conductivity 933 µS/cm, Iron color and some precipitate observed in stream just downstream of the pond. Sedimentation problems apparent, cement tailings from nearby cement facility spilled over the bank and appear to be contributing to sedimentation problems.

List any known sediment parameters of site-associated bodies of surface water:

Sediment type(s)

Grain Size _______ pH _____ Eh _____ pE_____

Total Organic Carbon

Acid-Volatile Sulfides

Other (specify):

(If more than one surface water body of each type, repeat information as needed.)

6. Does the site contain or drain into wetlands? _X_ Yes _____No

If Yes, what type(s) and size(s)? According to the National Wetland Inventory (NWI) Map for Hillsboro, Illinois (U.S. Fish and Wildlife Service, 1988), the only mapped wetlands on the site property include the southwest retention pond and the small pond located in the southeast part of the site. These ponds are mapped as "intermittently exposed palustrine wetlands with unconsolidated materials in diked or impounded areas."

List any known surface water and sediment parameters of site wetlands, as in #5, above.
See #5 above (ponds)

7. Describe sub-surface hydrology.

Overlying strata None

Aquifer Unconfined water table aquifer composed of stratified glacial deposits ranging from silty clay to clayey sand

Depth of aquifer Unknown

Location of groundwater discharge Eastern drainageway, western drainageway

Ecological Description

8. List and describe habitats that occur at the site.

Habitats are physically impacted by past, current and anticipated future industrial uses.

Woodlands Deciduous woods (see map)

Grasslands/open fields grasslands and open fields (see map)

Wetlands See stormwater pond locations

Ponds Southwest corner of site – retention pond; Southeast corner of site – retention pond; Northeast corner of site – 2 retention basins.

Streams Intermittent drainageways draining northeast and southwest portions of the site. Onsite drainageways dry during site visit.

Estuaries N/A

Coastal zones N/A

Flood plains N/A

Other natural areas N/A

List any known soil and sediment parameters for each terrestrial habitat.

Soil type(s)

Grain Size_________ pH ______ Eh ______ pE______

Total Organic Carbon

Total Phosphorus

Nitrogen forms

Other

9. Are any Federally or State listed endangered or threatened species known or suspected to occur on or near the site?

__________Yes __X__ No

Site visit and database search indicated no threatened or endangered species on or near the site (see attached correspondence).

If yes, list:

10. Does the site have any game specie s or species of interest for another reason? __X__Yes_____No

If yes, list:

Deer tracks observed, common in area.

Known Ecological Effects

11. Does the site show any evidence of adverse ecological effects? **X** ___ Yes______ No

If yes, list:

Intensive land use during past industrial activities has resulted in physical disturbances to habitats and resultant adverse ecological effects. Manufacturing areas and waste pile areas were cleared of trees, and soils were disturbed for industrial use, resulting in loss of habitat and surface runoff. Some adverse impacts were observed on some remaining trees; dead trees in northern part of site may be due to poor drainage. Sedimentation of nearfield offsite drainageways in the SW drainage has suppressed benthic life. Contributions to sedimentation from a nearby cement plant were apparent. Nearby reference sites had freshwater mussels and clams not observed in this area.

12. Documentation attached:

X ___ Site Map

X ___ Species List

X ___ Threatened and Endangered Species Correspondence

Species observed during July 15, 2002 site visit
Eagle Zinc Company Site

Dragonfly
Damselfly
Turtles, including Eastern Box Turtle
Green sunfish
Fathead minnow
Common shiner
Green heron
Songbirds
Whitetail deer
Raccoon tracks
Deer tracks
Frog
Crayfish

Nettles
Cottonwood
Willow
Locust
Phragmities (common reed)
Pondweed
Carex (sedge)

-----Original Message-----
From: TARA KIENINGER [mailto:TKIENINGER@dnrmail.state.il.us]
Sent: Monday, October 20, 2003 2:37 PM
To: Penelope Moskus
Subject: Re: Request for threatened and endangered species search

October 20, 2003

Penelope Moskus
Limno-Tech, Inc.
501 Avis Drive
Ann Arbor, MI 48108

Dear Ms. Moskus:

I have reviewed the information you provided via email today regarding the Eagle Zinc Company Site near Hillsboro, Illinois. According to the Illinois Natural Heritage Database, there are no endangered or threatened species within the site area you indicated, specifically Township 8 North, Range 4 West, Sections 1 & 12, Third Principal Meridian. Nor are there any listed species within 1 mile of the project site boundaries.

Please be aware that the Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of significant natural features in Illinois. The Department of Natural Resources and the Illinois Nature Preserves Commission can only summarize the existing information known to us at the time of the request. This report should not be regarded as a final statement on the area being considered, nor should it substitute for field surveys required for environmental assessments.

This letter is separate from the Illinois Department of Natural Resources consultation requirement under the Illinois Endangered Species Act (530 ILCS 10/11) and the Illinois Natural Areas Preservation Act (525 ILCS 30/17). For more information on this process, please contact the Illinois Department of Natural Resources, Division of Resource Review and Coordination, at One Natural Resources Way, Springfield, Illinois 62702-1271 or by telephone at (217)785-5500.

Tara Gibbs Kieninger, Database Administrator
Illinois Natural Heritage Database
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271
tkieninger@dnrmail.state.il.us
217.782.2685
217.785.2438 (fax)

J://EAGLE/Data/sitehabitats.apr, rev. 10703

Appendix C:
Photographs from Site Visits

Photos from July 2002 and March 2004 Site Visits

Abandoned buildings and manufacturing areas – July 2002

Residue piles in open areas of Site, looking northwest – March 2004

Southwest pond looking west from berm – March 2004

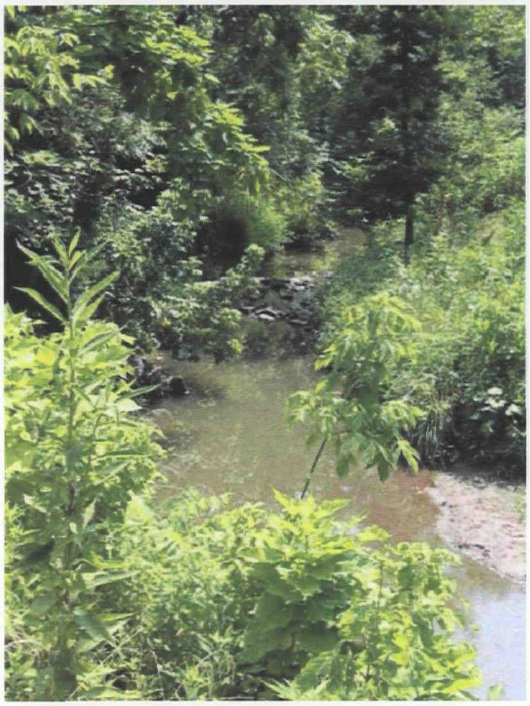
Pond in southwest portion of site, looking northeast up the basin – July 2002

Western drainage below confluence with south drainage showing filamentous algae, iron precipitate, and trash – March 2004

Frog in floodplain of western drainage – July 2002

Turtle in floodplain of western drainage – July 2002

Adult green sunfish in southwest pond – July 2002

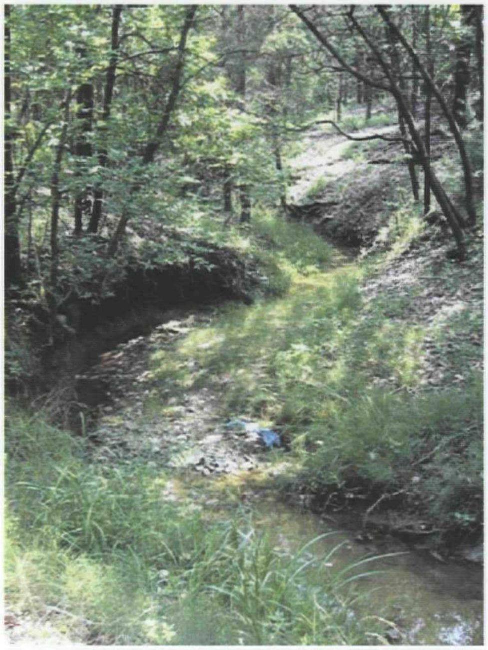


Tributary to Middle Fork Shoal Creek (receives drainage to west of site) – July 2002

Old field in northern portion of Site – March 2004

Dead trees north of manufacturing area showing proximity to buildings – March 2004

Stormwater retention basin eastern drainage – July 2002



Eastern drainage - upstream view,
150 meters downstream of Industrial Drive – July 2002

View across Lake Hillsboro with location of eastern drainage inflow
at center opposite – July 2002

Appendix D
Superfund Sites for Which On-Site Ecological Risk Assessment Not Conducted

Midco I, Gary, IN (Superfund, Region 5)
Midco I, Gary, IN (Superfund, Region 5)
Enviro-Chem Corporation, Zionsville, IN (Superfund, Region 5)
Velsicol Chemical, St. Louis, MI (Superfund, Region 5)
Fisher-Calo, LaPorte, IN (Superfund, Region 5)
Reilly Industries, Indianapolis, IN (Superfund, Region 5)

Appendix E:
Screening Thresholds

Chronic Surface Water Criteria for Aquatic Life

Sediment Quality Guidelines

Classification of Illinois Stream Sediments, Sieved

Classification of Illinois Stream Sediments, Unsieved

Toxicological Benchmarks for Wildlife

Appendix E – Chronic Surface Water Criteria for Aqatic Life

Enter value here	
Hardness	311

		Title 35 of the Illinois Administrative Code. Subpart B: General Use Water Quality Standards			Title 35 of the Illinois Administrative Code. Derived Water Quality Criteria for aquatic life		EPA National Recommended Water Quality Criteria: 2002	
Constituent	**Water quality criteria for ERA comparison (mg/l)**	**Acute standard (mg/l)** *Section 302:208 Section e*	**Chronic standard (mg/l)** *Section 302:208 Section e*	**Concentrations for the following chemical constituents shall not be exceeded except in waters for which mixing is allowed pursuant to Section 302:102** *Section 302:208 g*	**Acute (mg/l)**	**Chronic (mg/l)**	**CMC (mg/l)**	**CCC (mg/l)**
Chromium (hexavalent, total)	0.011	0.016	0.011				0.016	0.011
Chromium (trivalent, total)	0.524	4.398	0.524				4.566	0.218
Copper (total)	0.031	0.052	0.031				0.041	0.025
Lead (total)	0.085	0.406	0.085				0.346	0.013
Manganese (total)	1			1				
Zinc (total)	0.057	0.320	0.057				0.313	0.313
Iron (dissolved)	1			1				1
Sulfate	500			500				
Cadmium (total)	0.003	0.035	0.003				0.007	0.0006
Aluminum (total)	0.75						0.75	
Barium (total)	5			5				
Calcium								
Cobalt								
Magnesium								
Mercury (total)	0.001	0.003	0.001				0.001	0.001
Nickel (total)	0.013	0.216	0.013				1.225	0.136
Potassium								
Sodium								
Vanadium								
Antimony								
Arsenic	0.19	0.36	0.19				0.34	0.15
Beryllium								
Selenium	1			1				
Silver	1			1			0.027	
Trichloroethene	0.94				12	0.94		
1,2-dichloroethene[1,2]					14	1.1		

Blank cell means not available

[1] 1,2-dichloroethene standard is for cis +trans. No standard is available for cis 1,2-dichloroethene

[2] The values for 1,2-dichloroethylene were not calculated according to the regulations because there was not enough data. These values should be used for advisory purposes only such as establishing "reasonable potential."

Note: Some metals criteria are hardness-dependent. Criteria for hardness-dependent metals vary by area, depending on hardness. A representative hardness of 311 is used for this example.

Appendix E – Sediment Quality Guidelines

	Ingersoll et al. (1996)				Environment Canada (1995)		Ontario (1993)	
Chemical	**ERL (ug/g-dry)**	**ERM (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**LEL (ug/g-dry)**	**SEL (ug/g-dry)**
Metals								
Aluminum	--	58,000	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--
Arsenic	13.0	50	11	48	5.9	17	6	33
Barium	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--
Cadmium	0.7	3.9	0.58	3.2	0.596	3.53	0.6	10
Calcium	--	--	--	--	--	--	--	--
Chromium	39	270	36	120	37.3	90	26	110
Cobalt	--	--	--	--	--	--	--	--
Copper	41	190	28	100	35.7	197	16	110
Iron	200,000	280,000	190,000	250,000	--	--	20,000	40,000
Lead	55	99	37	82	35	91.3	31	250
Magnesium	--	--	--	--	--	--	--	--
Manganese	730	1,700	630	1,200	--	--	460	1,100
Mercury	--	--	--	--	0.174	0.486	0.2	2
Nickel	24	45	20	33	18	35.9	16	75
Potassium	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	110	550	98	540	123	315	120	820
Organics								
trans-1,2-Dichloroethene	--	--	--	--	--	--	--	--
Trichloro-ethene	--	--	--	--	--	--	--	--
Vinyl chloride	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	--	--	--	--	--	--	--	--
2-Butanone	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--

ERL = Effects range-low
ERM = Effects range-medium
TEL = Threshold effect level
PEL = Probable effect level
LEL = Lowest effect level
SEL = Severe effect level

Classification of Illinois EPA Sieved Stream Sediment Data Collected from 1982-1995 (IEPA, 1997).

Parameter	Units	Non-Elevated	Elevated	Highly Elevated
Arsenic	mg/kg	< 7.2	≥ 7.2	≥ 18
Barium	mg/kg	< 145	≥ 145	≥ 230
Cadmium	mg/kg	< 2.0	≥ 2.0	≥ 9.3
Chromium	mg/kg	< 16	≥ 23	≥ 38
Copper	mg/kg	< 37	≥ 37	≥ 110
Iron	mg/kg	< 26105	≥ 26105	≥ 53000
Lead	mg/kg	< 60	≥ 60	≥ 245
Manganese	mg/kg	< 1100	≥ 1100	≥ 2300
Mercury	mg/kg	< 0.28	≥ 0.28	≥ 1.40
Nickel	mg/kg	< 26	≥ 26	≥ 45
Potassium	mg/kg	< 1500	≥ 1500	≥ 2200
Silver	mg/kg	≤ 5	na	> 5
Zinc	mg/kg	< 170	≥ 170	≥ 760

Classification of Illinois Stream Sediments, unsieved (from Kelly and Hite, 1984)

Parameter	Units	Non-Elevated	Slightly Elevated	Elevated	Highly Elevated	Extreme
Arsenic	mg/kg	< 8	≥ 8	≥ 11	≥ 17	≥ 28
Cadmium	mg/kg	< 0.5	≥ 0.5	≥ 1.0	≥ 2.0	≥ 20.0
Chromium	mg/kg	< 16	≥ 16	≥ 23	≥ 38	≥ 60
Copper	mg/kg	< 38	≥ 38	≥ 60	≥ 100	≥ 200
Iron	mg/kg	< 18000	≥ 18000	≥ 23000	≥ 32000	≥ 50000
Lead	mg/kg	< 28	≥ 28	≥ 38	≥ 60	≥ 100
Manganese	mg/kg	< 1300	≥ 1300	≥ 1800	≥ 2800	≥ 5000
Mercury	mg/kg	< 0.07	≥ 0.07	≥ 0.10	≥ 0.17	≥ 0.30
Zinc	mg/kg	< 80	≥ 80	≥ 100	≥ 170	≥ 300

Combined Food and Water NOAEL-Based Benchmarks for Piscivorous Wildlife (mg/l contaminant in surface water)

	Great Blue Heron	Mink
Aluminum	2.699	0.025
Antimony	--	0.22
Arsenic	1.695	0.022
Barium	--	--
Beryllium	--	0.188
Cadmium	0.001	0.000437
Calcium	--	--
Chromium	--	--
Cobalt	--	--
Copper	0.921	0.294
Iron	--	--
Lead	0.142	0.982
Magnesium	--	--
Manganese	--	--
Mercury	--	--
Nickel	4.145	2.104
Potassium	--	--
Selenium	0.001094	1
Silver	--	--
Sodium	--	--
Vanadium	--	--
Zinc	0.085	0.929

Source: Sample, et al., 1996. Toxicological Benchmarks for Wildlife: 1996 Revision

Appendix F:
Exposure Data

Summary Tables of Water Data by Area

Summary Tables of Sediment Data by Area

Summary statistics for measured chemical concentrations in surface water

Area	East-Background
Station(s)	SW-ED-11

Chemical	Units	Mean/ value	SD	Min		Max	N	Note
Metals								
Aluminum	mg/l	0.17	--	0.17		0.17	1	
Antimony	mg/l	0.0025	--	0.0025	U	0.0025	1	U (1 sample)
Arsenic	mg/l	0.0081	--	0.0081	U	0.0081	1	U (1 sample)
Barium	mg/l	0.14	--	0.14		0.14	1	
Beryllium	mg/l	0.00061	--	0.00061	U	0.00061	1	U (1 sample)
Cadmium	mg/l	0.00053	--	0.00053	U	0.00053	1	U (1 sample)
Calcium	mg/l	88	--	88		88	1	
Chromium	mg/l	0.001	--	0.001		0.001	1	
Cobalt	mg/l	0.0009	--	0.0009	U	0.0009	1	U (1 sample)
Copper	mg/l	0.0044	--	0.0044		0.0044	1	
Iron	mg/l	0.28	--	0.28		0.28	1	
Lead	mg/l	0.0013	--	0.0013	U	0.0013	1	U (1 sample)
Magnesium	mg/l	12	--	12		12	1	
Manganese	mg/l	0.11	--	0.11		0.11	1	
Mercury	mg/l	0.000028	--	0.000028	U	0.000028	1	U (1 sample)
Nickel	mg/l	0.0025	--	0.0025		0.0025	1	
Potassium	mg/l	5.7	--	5.7		5.7	1	
Selenium	mg/l	0.0048	--	0.0048	U	0.0048	1	U (1 sample)
Silver	mg/l	0.0011	--	0.0011	U	0.0011	1	U (1 sample)
Sodium	mg/l	29	--	29		29	1	
Vanadium	mg/l	0.0015	--	0.0015		0.0015	1	
Zinc	mg/l	1.4	--	1.4		1.4	1	
Other inorganics								
Sulfate	mg/l	21	--	21		21	1	

U= Indicates undetected at concentration listed

one each. not sufficient

Summary statistics for measured chemical concentrations in surface water

Area	East-Offsite Nearfield
Station(s)	SW-ED-16, SW-ED-13

Chemical	Units	Mean/ value	SD	Min	Max	N	Note
Metals							
Aluminum	mg/l	0.0805	0.070	0.031	0.13	2	
Antimony	mg/l	0.0025	0.000	0.0025	0.0025	2	U (2 samples)
Arsenic	mg/l	0.0081	0.000	0.0081	0.0081	2	U (2 samples)
Barium	mg/l	0.0605	0.015	0.05	0.071	2	
Beryllium	mg/l	0.00061	0.000	0.00061	0.00061	2	U (2 samples)
Cadmium	mg/l	0.003815	0.005	0.00053	0.0071	2	U (1 sample)
Calcium	mg/l	61	26.870	42	80	2	
Chromium	mg/l	0.001015	0.000	0.00093	0.0011	2	U (1 sample)
Cobalt	mg/l	0.0009	0.000	0.0009	0.0009	2	U (2 sample)
Copper	mg/l	0.003	0.001	0.002	0.004	2	
Iron	mg/l	0.255	0.035	0.23	0.28	2	
Lead	mg/l	0.0013	0.000	0.0013	0.0013	2	U (2 samples)
Magnesium	mg/l	20.5	9.192	14	27	2	
Manganese	mg/l	0.24	0.198	0.1	0.38	2	
Mercury	mg/l	0.000028	0.000	0.000028	0.000028	2	U (2 samples)
Nickel	mg/l	0.0069	0.007	0.0018	0.012	2	
Potassium	mg/l	4.4	1.131	3.6	5.2	2	
Selenium	mg/l	0.0048	0.000	0.0048	0.0048	2	U (2 samples)
Silver	mg/l	0.0011	0.000	0.0011	0.0011	2	U (2 samples)
Sodium	mg/l	28	18.385	15	41	2	
Vanadium	mg/l	0.000855	0.000	0.00084	0.00087	2	U (1 sample)
Zinc	mg/l	5.92	7.184	0.84	11	2	
Other inorganics							
Sulfate	mg/l	145	21.213	130	160	2	

U= Indicates undetected at concentration listed
J= Estimated Value
NS= Not sampled

2 vals not really suff.

Summary statistics for measured chemical concentrations in surface water

Area	East- Offsite Farfield
Station(s)	IEPA 2000-2001 Data

Chemical	Units	Mean/ value	SD	Min	Max	N	Note
Metals							
Aluminum	mg/l	0.1	0.00	0.1	0.1	9	U (9 samples)
Antimony	mg/l						NS
Arsenic	mg/l	0.00188	0.00	0.0015	0.0024	5	U (5 samples)
Barium	mg/l	0.042	0.013	0.023	0.063	9	
Beryllium	mg/l	0.001	0.00	0.001	0.001	9	U (9 samples)
Cadmium	mg/l	0.003	0.00	0.003	0.003	9	U (9 samples)
Calcium	mg/l	32	5.24	27	44	9	
Chromium	mg/l	0.005	0.00	0.005	0.005	9	U (9 samples)
Cobalt	mg/l	0.01	0.00	0.01	0.01	9	U (9 samples)
Copper	mg/l	0.01	0.00	0.01	0.01	9	U (9 samples)
Iron	mg/l	0.13	0.07	0.051	0.26	9	
Lead	mg/l	0.005	0.00	0.005	0.005	5	U (5 samples)
Magnesium	mg/l	12	2.19	10	17	9	
Manganese	mg/l	0.16	0.05	0.08	0.22	9	
Mercury	mg/l						NS
Nickel	mg/l	0.025	0.00	0.025	0.025	9	U (9 samples)
Potassium	mg/l	6.1	0.37	5.6	6.6	9	
Selenium	mg/l	0.002	0.00	0.002	0.002	5	U (5 samples)
Silver	mg/l	0.003	0.00	0.003	0.003	9	U (9 samples)
Sodium	mg/l	14	2.55	10	19	9	
Vanadium	mg/l	0.005	0.00	0.005	0.005	9	U (9 samples)
Zinc	mg/l	0.10	0.00	0.10	0.10	9	U (9 samples)

U= Indicates undetected at concentration listed

J= Estimated Value

NS= Not sampled

Summary statistics for measured chemical concentrations in surface water

Area	West-Background-Tributary to South of Site
Station(s)	SW-WD-10

Chemical	Units	Mean/ value	SD	Min		Max	N	Note
Metals								
Aluminum	mg/l	0.21	--	0.21		0.21	1	
Antimony	mg/l	0.0025	--	0.0025	U	0.0025	1	U (1 sample)
Arsenic	mg/l	0.0081	--	0.0081	U	0.0081	1	U (1 sample)
Barium	mg/l	0.05	--	0.05		0.05	1	
Beryllium	mg/l	0.00061	--	0.00061	U	0.00061	1	U (1 sample)
Cadmium	mg/l	0.0058	--	0.0058		0.0058	1	
Calcium	mg/l	100	--	100		100	1	
Chromium	mg/l	0.0009	--	0.00093	U	0.00093	1	U (1 sample)
Cobalt	mg/l	0.0044	--	0.0044		0.0044	1	
Copper	mg/l	0.0059	--	0.0059		0.0059	1	
Iron	mg/l	15	--	15		15	1	
Lead	mg/l	0.0013	--	0.0013	U	0.0013	1	U (1 sample)
Magnesium	mg/l	26	--	26		26	1	
Manganese	mg/l	0.49	--	0.49		0.49	1	
Mercury	mg/l	0.00003	--	0.000034		0.000034	1	
Nickel	mg/l	0.013	--	0.013		0.013	1	
Potassium	mg/l	5.4	--	5.4		5.4	1	
Selenium	mg/l	0.0048	--	0.0048	U	0.0048	1	U (1 sample)
Silver	mg/l	0.0011	--	0.0011	U	0.0011	1	U (1 sample)
Sodium	mg/l	62	--	62		62	1	
Vanadium	mg/l	0.00084	--	0.00084	U	0.00084	1	U (1 sample)
Zinc	mg/l	3.7	--	3.7		3.7	1	
Other inorganics								
Sulfate	mg/l	95	--	95		95	1	

U= Indicates undetected at concentration listed

J= Estimated Value

NS= Not sampled

Summary statistics for measured chemical concentrations in surface water

Area: West-Background-Tributary to West of Site
Station(s): SW-WD-11

Chemical	Units	Mean/ value	SD	Min		Max	N	Note
Metals								
Aluminum	mg/l	1.1	--	1.1		1.1	1	
Antimony	mg/l	0.0003	--	0.0003	J	0.0003	1	J (1 sample)
Arsenic	mg/l	0.0023	--	0.0023	J	0.0023	1	J (1 sample)
Barium	mg/l	0.087	--	0.087		0.087	1	
Beryllium	mg/l	0.00021	--	0.00021	J	0.00021	1	J (1 sample)
Cadmium	mg/l	0.0002	--	0.00019	J	0.00019	1	J (1 sample)
Calcium	mg/l	38	--	38		38	1	
Chromium	mg/l	0.0016	--	0.0016	J	0.0016	1	J (1 sample)
Cobalt	mg/l	0.0008	--	0.00081	J	0.00081	1	J (1 sample)
Copper	mg/l	0.0037	--	0.0037	J	0.0037	1	J (1 sample)
Iron	mg/l	1.4	--	1.4		1.4	1	
Lead	mg/l	0.0038	--	0.0038		0.0038	1	
Magnesium	mg/l	11	--	11		11	1	
Manganese	mg/l	0.25	--	0.25		0.25	1	
Mercury	mg/l	0.0003	--	0.0003	U	0.0003	1	U (1 sample)
Nickel	mg/l	0.0029	--	0.0029	J	0.0029	1	J (1 sample)
Potassium	mg/l	5	--	5		5	1	
Selenium	mg/l	0.0013	--	0.0013	J	0.0013	1	J (1 sample)
Silver	mg/l	0.00008	--	0.00008	J	0.00008	1	J (1 sample)
Sodium	mg/l	17	--	17		17	1	
Vanadium	mg/l	0.0047	--	0.0047		0.0047	1	
Zinc	mg/l	0.072	--	0.072	U	0.072	1	U (1 sample)
Other inorganics								
Sulfate	mg/l	--	--	--		--	0	NS

J= Estimated Value
U= Indicates undetected at concentration listed
NS= Not sampled

Summary statistics for measured chemical concentrations in surface water

Area	West-Offsite Nearfield
Station(s)	SW-WD-6, SW-WD-6D, SW-WD-7, SW-WD-7D, SW-WD-8

Chemical	Units	Mean/ value	SD	Min	Max	N	Note
Metals							
Aluminum	mg/l	0.0432	0.0201	0.027	0.076	6	U (5 samples)
Antimony	mg/l	0.0018	0.0011	0.00026	0.0025	6	U (4 samples); J (2 samples)
Arsenic	mg/l	0.0058	0.0036	0.0012	0.0081	6	U (4 sample); J (2 samples)
Barium	mg/l	0.0360	0.0126	0.021	0.05	6	
Beryllium	mg/l	0.0004	0.0003	0.0001	0.00061	6	U (6 samples)
Cadmium	mg/l	0.0168	0.0145	0.0023	0.034	6	
Calcium	mg/l	123	28	86	150	6	
Chromium	mg/l	0.0008	0.0002	0.00061	0.00093	6	U (4 samples); J (2 samples)
Cobalt	mg/l	0.0010	0.0003	0.00084	0.0016	6	U (2 samples) J (2 samples)
Copper	mg/l	0.0032	0.0016	0.0011	0.0049	6	J (2 samples)
Iron	mg/l	0.93	1.11	0.39	3.2	6	
Lead	mg/l	0.0021	0.0007	0.0013	0.0028	6	U (2 samples)
Magnesium	mg/l	29	5	23	36	6	
Manganese	mg/l	0.31	0.21	0.08	0.62	6	
Mercury	mg/l	0.0001	0.0001	0.000028	0.0002	6	U (5 samples); J (1 sample)
Nickel	mg/l	0.0109	0.0062	0.0029	0.019	6	
Potassium	mg/l	7.2	1.8	5.1	9.2	6	
Selenium	mg/l	0.0039	0.0015	0.0019	0.0048	6	U (4 sample); J (2 samples)
Silver	mg/l	0.0008	0.0005	0.000049	0.0011	6	U (5 samples); J (1 sample)
Sodium	mg/l	46	14	29	60	6	J (1 sample)
Vanadium	mg/l	0.0008	0.0001	0.00065	0.00084	6	U (4 samples); J (2 samples)
Zinc	mg/l	12.5	11.2	1.2	26	6	
Other inorganics							
Sulfate	mg/l	268	49	210	330	4	

J= Estimated Value
U= Indicates undetected at concentration listed
NS= Not sampled

Summary statistics for measured chemical concentrations in surface water

Area: West-Offsite MF Shoal Ck Trib
Station(s): SW-WD-12

Chemical	Units	Mean/ value	SD	Min		Max	N	Note
Metals								
Aluminum	mg/l	1.4	--	1.4		1.4	1	
Antimony	mg/l	0.00032	--	0.00032	J	0.00032	1	J (1 sample)
Arsenic	mg/l	0.0022	--	0.0022	J	0.0022	1	J (1 sample)
Barium	mg/l	0.089	--	0.089		0.089	1	
Beryllium	mg/l	0.00018	--	0.00018	J	0.00018	1	J (1 sample)
Cadmium	mg/l	0.0012	--	0.0012		0.0012	1	
Calcium	mg/l	51	--	51		51	1	
Chromium	mg/l	0.0018	--	0.0018	J	0.0018	1	J (1 sample)
Cobalt	mg/l	0.0009	--	0.0009	J	0.0009	1	J (1 sample)
Copper	mg/l	0.0041	--	0.0041	J	0.0041	1	J (1 sample)
Iron	mg/l	1.6	--	1.6		1.6	1	
Lead	mg/l	0.0052	--	0.0052		0.0052	1	
Magnesium	mg/l	14	--	14		14	1	
Manganese	mg/l	0.27	--	0.27		0.27	1	
Mercury	mg/l	0.00002	--	0.00002	U	0.00002	1	U (1 sample)
Nickel	mg/l	0.0041	--	0.0041		0.0041	1	
Potassium	mg/l	5.5	--	5.5		5.5	1	
Selenium	mg/l	0.0014	--	0.0014	J	0.0014	1	J (1 sample)
Silver	mg/l	0.00006	--	0.00006	J	0.00006	1	J (1 sample)
Sodium	mg/l	24	--	24		24	1	
Vanadium	mg/l	0.0051	--	0.0051		0.0051	1	
Zinc	mg/l	0.71	--	0.71		0.71	1	
Other inorganics								
Sulfate	mg/l	--	--	--		--	0	NS

J= Estimated Value
U= Indicates undetected at concentration listed
NS= Not sampled

Summary statistics for measured chemical concentrations in sediment

Area	East-Background
Station(s)	SD-ED-11

Chemical	Units	Mean/ value	SD	Min		Max	N	Note
Metals								
Aluminum	mg/kg	6000	--	6000		6000	1	
Antimony	mg/kg	0.42	--	0.42		0.42	1	
Arsenic	mg/kg	2.1	--	2.1	J	2.1	1	J (1 sample)
Barium	mg/kg	68	--	68	J	68	1	J (1 sample)
Beryllium	mg/kg	0.42	--	0.42	J	0.42	1	J (1 sample)
Cadmium	mg/kg	0.91	--	0.91		0.91	1	
Calcium	mg/kg	1900	--	1900		1900	1	
Chromium	mg/kg	11	--	11	J	11	1	J (1 sample)
Cobalt	mg/kg	1.8	--	1.8		1.8	1	
Copper	mg/kg	7.5	--	7.5		7.5	1	
Iron	mg/kg	5100	--	5100		5100	1	
Lead	mg/kg	14	--	14		14	1	
Magnesium	mg/kg	740	--	740	J	740	1	J (1 sample)
Manganese	mg/kg	130	--	130		130	1	
Mercury	mg/kg	0.013	--	0.013	J	0.013	1	J (1 sample)
Nickel	mg/kg	5	--	5	A	5	1	A (1 sample)
Potassium	mg/kg	720	--	720	J	720	1	J (1 sample)
Selenium	mg/kg	0.49	--	0.49	UJ	0.49	1	UJ (1 sample)
Silver	mg/kg	0.074	--	0.074	U	0.074	1	U (1 sample)
Sodium	mg/kg	--	--	--	--	--	0	A (1 sample - omitted from analysis)
Vanadium	mg/kg	14	--	14	J	14	1	J (1 sample)
Zinc	mg/kg	460	--	460	J	460	1	J (1 sample)

U= Indicates undetected at concentration listed

J= Estimated Value

A= compound was also detected in the method blank

NS=Not sampled

Summary statistics for measured chemical concentrations in sediment

Area	East- Offsite Nearfield
Station(s)	SD-ED-13, SD-ED-14, SD-ED-15, SD-ED-16

Chemical	Units	Mean/ value	SD	Min	Max	N	Note
Metals							
Aluminum	mg/kg	6250	2496.00	3900	9600	4	
Antimony	mg/kg	1.71	0.62	0.84	2.30	4	
Arsenic	mg/kg	5.6	1.7	3.2	7.2	4	J (4 samples)
Barium	mg/kg	59	11.32	44	71	4	J (4 samples)
Beryllium	mg/kg	0.52	0.16	0.39	0.75	4	J (4 samples)
Cadmium	mg/kg	7.0	4.9	2.3	13.0	4	
Calcium	mg/kg	12025	8725.58	4100	23000	4	
Chromium	mg/kg	9.9	3.0	7.1	14.0	4	J (4 samples)
Cobalt	mg/kg	8.0	2.7	6.0	12.0	4	
Copper	mg/kg	32.0	24.3	4.8	53.0	4	
Iron	mg/kg	13375	4607.51	8500	19000	4	
Lead	mg/kg	67	31.42	20	87	4	
Magnesium	mg/kg	3475	1481.83	1800	5400	4	J (4 samples)
Manganese	mg/kg	555	220.38	340	750	4	
Mercury	mg/kg	0.0607	0.0645	0.0046	0.1500	4	U (1 sample)
Nickel	mg/kg	13.7	4.0	7.9	17.0	4	
Potassium	mg/kg	613	180.62	440	860	4	J (3 samples, UJ (1 sample)
Selenium	mg/kg	0.55	0.12	0.44	0.72	4	UJ (3 samples)
Silver	mg/kg	0.249	0.206	0.066	0.460	4	U (2 samples)
Sodium	mg/kg	56	42.43	26	86	2	UJ (1 sample), UJA (1 sample)
Vanadium	mg/kg	19	6	15	27	4	J (3 samples), U (1 sample)
Zinc	mg/kg	6258	4517.58	530	11000	4	J (4 samples)

U= Indicates undetected at concentration listed

J= Estimated Value

A= compound was also detected in the method blank

NS= Not sampled

Summary statistics for measured chemical concentrations in sediment

Area	West-Background Tributary to South of Site
Station(s)	SD-WD-10

Chemical	Units	Mean/ value	SD	Min		Max	N	Note
Metals								
Aluminum	mg/kg	12000	--	12000		12000	1	
Antimony	mg/kg	2.1	--	2.1		2.1	1	
Arsenic	mg/kg	15	--	15	J	15	1	J (1 sample)
Barium	mg/kg	86	--	86	J	86	1	J (1 sample)
Beryllium	mg/kg	0.92	--	0.92	J	0.92	1	J (1 sample)
Cadmium	mg/kg	1.4	--	1.4		1.4	1	
Calcium	mg/kg	5500	--	5500		5500	1	
Chromium	mg/kg	27	--	27	J	27	1	J (1 sample)
Cobalt	mg/kg	6.1	--	6.1		6.1	1	
Copper	mg/kg	30	--	30		30	1	
Iron	mg/kg	16000	--	16000		16000	1	
Lead	mg/kg	46	--	46		46	1	
Magnesium	mg/kg	1800	--	1800	J	1800	1	J (1 sample)
Manganese	mg/kg	100	--	100		100	1	
Mercury	mg/kg	0.057	--	0.057		0.057	1	
Nickel	mg/kg	16	--	16		16	1	A (1 sample)
Potassium	mg/kg	1200	--	1200	J	1200	1	J (1 sample)
Selenium	mg/kg	1.1	--	1.1	UJ	1.1	1	UJ (1 sample)
Silver	mg/kg	0.15	--	0.15	U	0.15	1	U (1 sample)
Sodium	mg/kg	96	--	96	UJ	96	1	UJA (1 sample)
Vanadium	mg/kg	26	--	26	J	26	1	J (1 sample)
Zinc	mg/kg	920	--	920	J	920	1	J (1 sample)

U= Indicates undetected at concentration listed
J= Estimated Value
A= compound was also detected in the method blank
NS= Not sampled

Summary statistics for measured chemical concentrations in sediment

Area	West-Background Tributary to West of Site
Station(s)	SD-WD-5

Chemical	Units	Mean/ value	SD	Min		Max	N	Note
Metals								
Aluminum	mg/kg	2800		2800		2800	1	
Antimony	mg/kg	0.58		0.58		0.58	1	
Arsenic	mg/kg	5.4		5.4	J	5.4	1	J (1 sample)
Barium	mg/kg	65		65	J	65	1	J (1 sample)
Beryllium	mg/kg	0.45		0.45	J	0.45	1	J (1 sample)
Cadmium	mg/kg	0.48		0.48		0.48	1	
Calcium	mg/kg	18000		18000		18000	1	
Chromium	mg/kg	7.3		7.3	J	7.3	1	J (1 sample)
Cobalt	mg/kg	3.5		3.5		3.5	1	
Copper	mg/kg	9.6		10		10	1	
Iron	mg/kg	11000		11000		11000	1	
Lead	mg/kg	28		28		28	1	
Magnesium	mg/kg	2100		2100	J	2100	1	J (1 sample)
Manganese	mg/kg	480		480		480	1	
Mercury	mg/kg	0.0093		0.0093		0.0093	1	
Nickel	mg/kg	6.5		6.5		6.5	1	A (1 sample)
Potassium	mg/kg	320		320	J	320	1	J (1 sample)
Selenium	mg/kg	0.64		0.64	UJ	0.64	1	UJ (1 sample)
Silver	mg/kg	0.1		0.1	U	0.1	1	U (1 sample)
Sodium	mg/kg	150		150	J	150	1	JA (1 sample)
Vanadium	mg/kg	11		11	J	11	1	J (1 sample)
Zinc	mg/kg	310		310	J	310	1	J (1 sample)

U= Indicates undetected at concentration listed
J= Estimated Value
A= compound was also detected in the method blank
NS= Not sampled

Summary statistics for measured chemical concentrations in sediment

Area	West-Offsite Nearfield
Station(s)	SD-WD-6, SD-WD-7, SD-WD-8

Chemical	Units	Mean/ value	SD	Min	Max	N	Note
Metals							
Aluminum	mg/kg	9867	7986	4200	19000	3	J (1 sample)
Antimony	mg/kg	5.5	5.66	1.7	12	3	
Arsenic	mg/kg	13	10	7	25	3	J (3 samples)
Barium	mg/kg	119	64	67	190	3	J (3 samples)
Beryllium	mg/kg	0.77	0.29816	0.52	1.1	3	J (3 samples)
Cadmium	mg/kg	45	44	17	96	3	
Calcium	mg/kg	3033	513	2600	3600	3	
Chromium	mg/kg	19	8	10	26	3	J (3 samples)
Cobalt	mg/kg	8.1	5.2	4.1	14.0	3	
Copper	mg/kg	156	144	51	320	3	
Iron	mg/kg	28333	14434	20000	45000	3	
Lead	mg/kg	1147	1348	290	2700	3	J (1 sample)
Magnesium	mg/kg	1500	700	1000	2300	3	
Manganese	mg/kg	283	150	110	380	3	
Mercury	mg/kg	0.82	0.62	0.16	1.40	3	
Nickel	mg/kg	22	8	12	27	3	
Potassium	mg/kg	803	527	400	1400	3	J (3 samples)
Selenium	mg/kg	0.92	0.42	0.62	1.40	3	UJ (2 samples), J (1 sample)
Silver	mg/kg	1.21	1.09	0.25	2.40	3	J (1 sample)
Sodium	mg/kg	46	37	23	89	3	UJ (2 samples)
Vanadium	mg/kg	22	9	13	30	3	J (3 samples)
Zinc	mg/kg	13533	8286	7600	23000	3	J (3 samples)

U= Indicates undetected at concentration listed

J= Estimated Value

A= compound was also detected in the method blank

Summary statistics for measured chemical concentrations in sediment

Area	West-Offsite Middle Fork Shoal Creek Tributary
Station(s)	SD-WD-1, SD-WD-2, SD-WD-3, SD-WD-4

Chemical	Units	Mean/ value	SD	Min		Max	N	Note
Metals								
Aluminum	mg/kg	4650	2726	2300		7700	4	
Antimony	mg/kg	0.57	0.18	0.45	U	0.83	4	U (1 sample)
Arsenic	mg/kg	3.25	0.58	2.50	J	3.90	4	J (4 samples)
Barium	mg/kg	46.00	10.74	30.00	J	53.00	4	J (4 samples)
Beryllium	mg/kg	0.34	0.07	0.27	J	0.43	4	J (4 samples)
Cadmium	mg/kg	1.15	0.34	0.83		1.60	4	
Calcium	mg/kg	9850	2999	7200		14000	4	
Chromium	mg/kg	7.40	1.35	5.90	J	8.90	4	J (4 samples)
Cobalt	mg/kg	3.03	0.90	1.90		4.00	4	
Copper	mg/kg	14.40	9.22	5.70		27.00	4	
Iron	mg/kg	7725	1396	6900		9800	4	
Lead	mg/kg	34.00	10.30	26.00		49.00	4	
Magnesium	mg/kg	2175	457	1700	J	2700	4	J (4 samples)
Manganese	mg/kg	293	103	190		420	4	
Mercury	mg/kg	0.04	0.02	0.01		0.07	4	
Nickel	mg/kg	6.13	2.14	4.20		8.90	4	A (4 samples)
Potassium	mg/kg	403	142	270	J	570	4	J (4 samples)
Selenium	mg/kg	0.58	0.07	0.52	UJ	0.67	4	UJ (4 samples)
Silver	mg/kg	0.09	0.01	0.09	U	0.10	4	U (3 samples)
Sodium	mg/kg	88.00	--	88.00	UJ	88.00	1	UJA (4 samples), omitted 3 samples from analysis
Vanadium	mg/kg	10.08	1.83	7.80	J	12.00	4	J (4 samples)
Zinc	mg/kg	705	466	400	J	1400	4	J (4 samples)

U= Indicates undetected at concentration listed
J= Estimated Value
A= compound was also detected in the method blank
NS=Not sampled

Appendix G:
Hazard Quotient Tables

Surface Water Hazard Quotients by Area

Sediment Hazard Quotients by Area

Western Drainage

Hazard quotients for aquatic life based on surface water exposures

Chemical	Surface Water Toxicity Screening Value (mg/l)				Maximum Surface Water Concentration (mg/l)				HQ			
	West background trib to south	West background trib to west	West offsite nearfield	West offsite MF Shoal Ck Trib	West background trib to south	West background trib to west	West offsite nearfield	West offsite MF Shoal Ck Trib	West background trib to south	West background trib to west	West offsite nearfield	West offsite MF Shoal Ck Trib
Metals (total)												
Aluminum	0.75	0.75	0.75	0.75	0.21	1.1	0.076 U	1.4	0.28	1.5	0.10	1.9
Antimony	--	--	--	--	0.0025 U	0.0003 J	0.0025 U	0.00032 J	--	--	--	--
Arsenic	0.19	0.19	0.19	0.19	0.0081 U	0.0023 J	0.0081 U	0.0022 J	0.04	0.0	0.04	0.0
Barium	5	5	5	5	0.05	0.087	0.05	0.089	0.01	0.02	0.01	0.02
Beryllium	--	--	--	--	0.00061 U	0.00021 J	0.00061 U	0.00018 J	--	--	--	--
Cadmium	0.003	0.001	0.003	0.002	0.0058	0.00019 J	0.034	0.0012	1.9	0.13	12.4	0.65
Calcium	--	--	--	--	100	38	150	51	--	--	--	--
Chromium	0.011	0.011	0.011	0.011	0.00093 U	0.0016 J	0.00093 U	0.0018 J	0.08	0.15	0.08	0.16
Cobalt	--	--	--	--	0.0044	0.00081 J	0.0016	0.0009 J	--	--	--	--
Copper	0.035	0.016	0.031	0.020	0.0059	0.0037 J	0.0049	0.0041 J	0.17	0.23	0.16	0.20
Iron[b]	1	1	1	1	15	1.4	3.2	1.6	15.00	1.40	3.20	1.60
Lead	0.101	0.031	0.084	0.044	0.0013 U	0.0038	0.0028	0.0052	0.01	0.12	0.03	0.12
Magnesium	--	--	--	--	26	11	36	14	--	--	--	--
Manganese	1	1	1	1	0.49	0.25	0.62	0.27	0.49	0.25	0.62	0.27
Mercury	0.001	0.001	0.001	0.001	0.000034	0.0003 U	0.0002 U	0.00002 U	0.03	0.23	0.15	0.02
Nickel	0.015	0.007	0.013	0.008	0.013	0.0029 J	0.019	0.0041	0.89	0.44	1.46	0.49
Potassium	--	--	--	--	5.4	5	9.2	5.5	--	--	--	--
Selenium	1	1	1	1	0.0048 U	0.0013 J	0.0048 U	0.0014 J	0.00	0.00	0.00	0.00
Silver	1	1	1	1	0.0011 U	0.00008 J	0.0011 U	0.00006 J	0.00	0.00	0.00	0.00
Sodium	--	--	--	--	62	17	60	24	--	--	--	--
Vanadium	--	--	--	--	0.00084 U	0.0047	0.00084 U	0.0051	--	--	--	--
Zinc	0.064	0.029	0.057	0.037	3.7	0.072 U	26	0.71	57.5	2.5[a]	456.9	19.3
Other inorganics												
Sulfate	500	500	500	500	95	--	330	--	0.19	--	0.66	--

Notes

[a] HQ >1 but non detected (DL is greater than screening value)

[b]Iron criteria is only available for dissolved iron. Iron flocculates and can pose problems to aquatic life when >1 mg/l, so this value was used for the screening level.

-- means no value available

HQ >1

Eastern Drainage

Hazard quotients for aquatic life based on surface water exposures

Chemical	Surface Water Toxicity Screening Value (mg/l)			Maximum Surface Water Concentration (mg/l)						HQ		
	East background	East offsite nearfield	East offsite farfield	East background		East offsite nearfield		East offsite farfield		East background	East offsite nearfield	East offsite farfield
Metals (total)												
Aluminum	0.75	0.75	0.75	0.17		0.13		0.1	U	0.23	0.17	0.13
Antimony	--	--	--	0.0025	U	0.0025	U			--	--	
Arsenic	0.19	0.19	0.19	0.0081	U	0.0081	U	0.0024	U	0.04	0.04	0.01
Barium	5	5	5	0.14		0.071		0.063		0.03	0.01	0.01
Beryllium	--	--	--	0.00061	U	0.00061	U	0.001	U	--	--	
Cadmium	0.00247	0.00166	0.00166	0.00053	U	0.0071		0.003	U	0.21	4.27	1.80[a]
Calcium	--	--	--	88		80		44		--	--	
Chromium	0.011	0.011	0.011	0.001		0.0011		0.005	U	0.09	0.10	0.45
Cobalt	--	--	--	0.0009	U	0.0009	U	0.01	U	--	--	
Copper	0.028	0.018	0.018	0.0044		0.004		0.01	U	0.16	0.22	0.56
Iron[b]	1	1	1	0.28		0.28		0.26		0.28	0.28	0.26
Lead	0.071	0.037	0.037	0.0013	U	0.0013	U	0.005	U	0.02	0.03	0.13
Magnesium	--	--	--	12		27		17		--	--	
Manganese	1	1	1	0.11		0.38		0.22		0.11	0.38	0.22
Mercury	0.0013	0.0013	0.0013	0.000028	U	0.000028	U			0.02	0.02	0.00
Nickel	0.0116	0.0076	0.0076	0.0025		0.012		0.025	U	0.22	1.59	3.31[a]
Potassium	--	--	--	5.7		5.2		6.6		--	--	
Selenium	1	1	1	0.0048	U	0.0048	U	0.002	U	0.0048	0.0048	0.00
Silver	1	1	1	0.0011	U	0.0011	U	0.003		0.0011	0.0011	0.00
Sodium	--	--	--	29		41		19		--	--	
Vanadium	--	--	--	0.0015		0.00087		0.005	U	--	--	
Zinc	0.0506	0.0331	0.0331	1.4		11		0.1	U	27.7	332.4	3.02[a]
Other inorganics												
Sulfate	500	500	500	21		160				0.04	0.32	0.00

Notes

[a] HQ >1 but non detected (DL is greater than screening value)

[b]Iron criteria is only available for dissolved iron. Iron flocculates and can pose problems to aquatic life when >1 mg/l, so this value was used for the screening level.

-- means no value available

Hazard quotients for piscivores based on surface water exposures

	Surface Water Toxicity Screening Value (mg/l)		Maximum Surface Water Concentration (mg/l)				HQ - Great Blue Heron				HQ - Mink			
Chemical	GBH	Mink	West background trib to south	West background trib to west	West offsite nearfield	West offsite MF Shoal Ck Trib	West background trib to south	West background trib to west	West offsite nearfield	West offsite MF Shoal Ck Trib	West background trib to south	West background trib to west	West offsite nearfield	West offsite MF Shoal Ck Trib
Metals (total)														
Aluminum	2.699	0.025	0.21	1.1	0.076 U	1.4	0.08	0.41	0.03	0.52	8.40	44.00	3.04[a]	56.00
Antimony	--	0.22	0.0025 U	0.0003 J	0.0025 U	0.00032 J	--	--	--	--	0.01	0.00	0.01	0.00
Arsenic	1.695	0.022	0.0081 U	0.0023 J	0.0081 U	0.0022 J	0.005	0.001	0.005	0.001	0.37	0.10	0.37	0.10
Barium	--	--	0.05	0.087	0.05	0.089	--	--	--	--	--	--	--	--
Beryllium	--	0.188	0.00061 U	0.00021 J	0.00061 U	0.00018 J	--	--	--	--	0.00	0.00	0.00	0.00
Cadmium	0.001	0.000437	0.0058	0.00019 J	0.034	0.0012	5.80	0.19	34.00	1.20	13.28	0.44	77.86	2.75
Calcium	--	--	100	38	150	51	--	--	--	--	--	--	--	--
Chromium[a]	--	--	0.00093 U	0.0016 J	0.00093 U	0.0018 J	--	--	--	--	--	--	--	--
Cobalt	--	--	0.0044	0.00081 J	0.0016	0.0009 J	--	--	--	--	--	--	--	--
Copper	0.921	0.294	0.0059	0.0037 J	0.0049	0.0041 J	0.006	0.004	0.005	0.004	0.02	0.01	0.02	0.01
Iron[b]	--	--	15	1.4	3.2	1.6	--	--	--	--	--	--	--	--
Lead	0.142	0.982	0.0013 U	0.0038	0.0028	0.0052	0.01	0.03	0.02	0.04	0.00	0.00	0.00	0.01
Magnesium	--	--	26	11	36	14	--	--	--	--	--	--	--	--
Manganese	--	--	0.49	0.25	0.62	0.27	--	--	--	--	--	--	--	--
Mercury	--	--	0.000034	0.0003 U	0.0002 U	0.00002 U	--	--	--	--	--	--	--	--
Nickel	4.145	2.104	0.013	0.0029 J	0.019	0.0041	0.003	0.001	0.005	0.001	0.01	0.00	0.01	0.00
Potassium	--	--	5.4	5	9.2	5.5	--	--	--	--	--	--	--	--
Selenium	0.001094	1	0.0048 U	0.0013 J	0.0048 U	0.0014 J	4.4[a]	1.20	4.4[a]	1.30	0.00	0.00	0.00	0.00
Silver	--	--	0.0011 U	0.00008 J	0.0011 U	0.00006 J	--	--	--	--	--	--	--	--
Sodium	--	--	62	17	60	24	--	--	--	--	--	--	--	--
Vanadium	--	--	0.00084 U	0.0047	0.00084 U	0.0051	--	--	--	--	--	--	--	--
Zinc	0.085	0.929	3.7	0.072 U	26	0.71	43.5	0.8	305.9	8.4	4.0	0.1	28.0	0.8
Other inorganics														
Sulfate	--	--	95	--	330	--	--	--	--	--	--	--	--	--

Notes

[a] HQ >1 but non detected (DL is greater than screening value)

[b] Iron criteria is only available for dissolved iron. Iron flocculates and can pose problems to aquatic life when >1 mg/l, so this value was used for the screening level.

-- means no value available

HQ >1

Eastern Drainage

Hazard quotients for piscivores based on surface water exposures

Chemical	Surface Water Toxicity Screening Value (mg/l) GBH	Surface Water Toxicity Screening Value (mg/l) Mink	Maximum Surface Water Concentration (mg/l) East background		East offsite nearfield		East offsite farfield		HQ - Great Blue Heron East background	HQ - Great Blue Heron East offsite nearfield	HQ - Great Blue Heron East offsite farfield	HQ - Mink East background	HQ - Mink East offsite nearfield	HQ - Mink East offsite farfield
Metals (total)														
Aluminum	2.699	0.025	0.17		0.13		0.1	U	0.06	0.05	0.04	6.80	5.20	4.0[a]
Antimony	--	0.22	0.0025	U	0.0025	U			--	--		0.01	0.01	0.00
Arsenic	1.695	0.022	0.0081	U	0.0081	U	0.0024	U	0.00	0.00	0.00	0.37	0.37	0.11
Barium	--	--	0.14		0.071		0.063		--	--	--	--	--	--
Beryllium	--	0.188	0.00061	U	0.00061	U	0.001	U	--	--		0.00	0.00	0.01
Cadmium	0.001	0.000437	0.00053	U	0.0071		0.003	U	0.53	7.10	3.0[a]	1.2[a]	16.26	6.9[a]
Calcium	--	--	88		80		44		--	--		--	--	--
Chromium[a]	--	--	0.001		0.0011		0.005	U	--	--	--	--	--	--
Cobalt	--	--	0.0009	U	0.0009	U	0.01	U	--	--		--	--	--
Copper	0.921	0.294	0.0044		0.004		0.01	U	0.00	0.00	0.01	0.01	0.01	0.03
Iron[b]	1	1	0.28		0.28		0.26		0.28	0.28	0.26	0.28	0.28	0.26
Lead	0.142	0.982	0.0013	U	0.0013	U	0.005	U	0.01	0.01	0.04	0.0013	0.0013	0.0051
Magnesium	--	--	12		27		17		--	--		--	--	--
Manganese	--	--	0.11		0.38		0.22		--	--	--	--	--	--
Mercury	--	--	0.000028	U	0.000028	U			--	--	--	--	--	--
Nickel	4.145	2.104	0.0025		0.012		0.025	U	0.00	0.00	0.01	0.00	0.01	0.01
Potassium	--	--	5.7		5.2		6.6		--	--		--	--	--
Selenium	0.001094	1	0.0048	U	0.0048	U	0.002	U	4.4[a]	4.4[a]	1.8[a]	0.0048	0.0048	0.0020
Silver	--	--	0.0011	U	0.0011	U	0.003		--	--	--	--	--	--
Sodium	--	--	29		41		19		--	--		--	--	--
Vanadium	--	--	0.0015		0.00087		0.005	U	--	--		--	--	--
Zinc	0.085	0.929	1.4		11		0.1	U	16.47	129.41	1.2[a]	1.51	11.84	0.11
Other inorganics														
Sulfate	500	500	21		160				0.0420	0.0000	0.0000			

Notes

[a] HQ >1 but non detected (DL is greater than screening value)

[b]Iron criteria is only available for dissolved iron. Iron flocculates and can pose problems to aquatic life when >1 mg/l, so this value was used for the screening level.

-- means no value available

HQ >1

Hazard quotients for aquatic life based on sediment exposures

Area: East-Background

Chemical	Hazard Quotients: Ingersoll et al. (1996) ERL (ug/g-dry)	ERM (ug/g-dry)	TEL (ug/g-dry)	PEL (ug/g-dry)	Environment Canada (1995) TEL (ug/g-dry)	PEL (ug/g-dry)	Ontario (1993) LEL (ug/g-dry)	SEL (ug/g-dry)
Metals								
Aluminum	--	0.10	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--
Arsenic	0.16	0.04	0.19	0.04	0.36	0.12	0.35	0.06
Barium	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--
Cadmium	1.30	0.23	1.57	0.28	1.53	0.26	1.52	0.09
Calcium	--	--	--	--	--	--	--	--
Chromium	0.28	0.04	0.31	0.09	0.29	0.12	0.42	0.10
Cobalt	--	--	--	--	--	--	--	--
Copper	0.18	0.04	0.27	0.08	0.21	0.04	0.47	0.07
Iron	0.03	0.02	0.03	0.02	--	--	0.3	0.13
Lead	0.25	0.14	0.38	0.17	0.40	0.15	0.45	0.06
Magnesium	--	--	--	--	--	--	--	--
Manganese	0.18	0.08	0.21	0.11	--	--	0.28	0.12
Mercury	--	--	--	--	0.07	0.03	0.07	0.01
Nickel	0.21	0.11	0.25	0.15	0.28	0.14	0.31	0.07
Potassium	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	12.72[a]	2.545[a]	14.29[a]	2.59[a]	11.38[a]	4.44[a]	3.83[a]	0.56[a]

ERL = Effects range-low
ERM = Effects range-medium
TEL = Threshold effect level
PEL = Probable effect level
LEL = Lowest effect level
SEL = Severe effect level
[a] HQ for LEL is >1, and measured sediment concentration had a J flag (estimated value)
HQ > 1

TRVs should be included here

Maximum Sediment Concentration

Chemical	Max (ug/g-dry)	Flag
Metals		
Aluminum	6000	
Antimony	0.42	
Arsenic	2.1	J
Barium	68	J
Beryllium	0.42	J
Cadmium	0.91	
Calcium	1900	
Chromium	11	J
Cobalt	1.8	
Copper	7.5	
Iron	5100	
Lead	14	
Magnesium	740	J
Manganese	130	
Mercury	0.013	J
Nickel	5	A
Potassium	720	J
Selenium	0.49	UJ
Silver	0.074	U
Sodium	--	
Vanadium	14	J
Zinc	460	J

Hazard quotients for aquatic life based on sediment exposures

Area: East-Offsite Nearfield

	Hazard Quotients									Maximum Sediment Concentration	
	Ingersoll et al. (1996)				Environment Canada (1995)		Ontario (1993)				
Chemical	**ERL (ug/g-dry)**	**ERM (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**LEL (ug/g-dry)**	**SEL (ug/g-dry)**	**Chemical**	**Max (ug/g-dry)**	**Flag**
Metals									**Metals**		
Aluminum	--	0.17	--	--	--	--	--	--	Aluminum	9600	
Antimony	--	--	--	--	--	--	--	--	Antimony	2.30	
Arsenic	0.55	0.14	0.65	0.15	1.22[a]	0.42	1.2[a]	0.22	Arsenic	7.2	J
Barium	--	--	--	--	--	--	--	--	Barium	71	J
Beryllium	--	--	--	--	--	--	--	--	Beryllium	0.75	J
Cadmium	18.57	3.33	22.41	4.06	21.81	3.68	21.67	1.30	Cadmium	13.0	
Calcium	--	--	--	--	--	--	--	--	Calcium	23000	
Chromium	0.36	0.05	0.39	0.12	0.38	0.16	0.54	0.13	Chromium	14.0	J
Cobalt	--	--	--	--	--	--	--	--	Cobalt	12.0	
Copper	1.29	0.28	1.89	0.53	1.48	0.27	3.31	0.48	Copper	53.0	
Iron	0.10	0.07	0.10	0.08	--	--	1.0	0.48	Iron	19000	
Lead	1.58	0.88	2.35	1.06	2.49	0.95	2.81	0.35	Lead	87	
Magnesium	--	--	--	--	--	--	--	--	Magnesium	5400	J
Manganese	1.03	0.44	1.19	0.63	--	--	1.63	0.68	Manganese	750	
Mercury	--	--	--	--	0.86	0.31	0.75	0.08	Mercury	0.1500	
Nickel	0.71	0.38	0.85	0.52	0.94	0.47	1.06	0.23	Nickel	17.0	
Potassium	--	--	--	--	--	--	--	--	Potassium	860	J
Selenium	--	--	--	--	--	--	--	--	Selenium	0.72	UJ
Silver	--	--	--	--	--	--	--	--	Silver	0.460	
Sodium	--	--	--	--	--	--	--	--	Sodium	86	UJ
Vanadium	--	--	--	--	--	--	--	--	Vanadium	27	J
Zinc	100.00	20.00	112.24	20.37	89.43	34.92	91.7[a]	13.41	Zinc	11000	J

ERL = Effects range-low
ERM = Effects range-medium
TEL = Threshold effect level
PEL = Probable effect level
LEL = Lowest effect level
SEL = Severe effect level
[a] HQ for LEL is >1, and measured sediment concentration had a J flag (estimated value)
HQ > 1

Hazard quotients for aquatic life based on sediment exposures

Area: West-Background Tributary to South of Site

	Hazard Quotients							
	Ingersoll et al. (1996)				Environment Canada (1995)		Ontario (1993)	
Chemical	**ERL (ug/g-dry)**	**ERM (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**LEL (ug/g-dry)**	**SEL (ug/g-dry)**
Metals								
Aluminum	--	0.21	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--
Arsenic	1.15[a]	0.30	1.36[a]	0.31	2.54[a]	0.88	2.5[a]	0.45
Barium	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--
Cadmium	2.00	0.36	2.41	0.44	2.35	0.40	2.33	0.14
Calcium	--	--	--	--	--	--	--	--
Chromium	0.69	0.10	0.75	0.23	0.72	0.30	1.04[a]	0.25
Cobalt	--	--	--	--	--	--	--	--
Copper	0.73	0.16	1.07	0.30	0.84	0.15	1.88	0.27
Iron	0.08	0.06	0.08	0.06	--	--	0.8	0.40
Lead	0.84	0.46	1.24	0.56	1.31	0.50	1.48	0.18
Magnesium	--	--	--	--	--	--	--	--
Manganese	0.14	0.06	0.16	0.08	--	--	0.22	0.09
Mercury	--	--	--	--	0.33	0.12	0.29	0.03
Nickel	0.67	0.36	0.80	0.48	0.89	0.45	1.00	0.21
Potassium	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	8.36[a]	1.67[a]	9.39[a]	1.7[a]	7.48[a]	2.92[a]	7.67[a]	1.12[a]

Maximum Sediment Concentration		
Chemical	**Max (ug/g-dry)**	**Flag**
Metals		
Aluminum	12000.00	
Antimony	2.10	
Arsenic	15.00	J
Barium	86.00	J
Beryllium	0.92	J
Cadmium	1.40	
Calcium	5500.00	
Chromium	27.00	J
Cobalt	6.10	
Copper	30.00	
Iron	16000.00	
Lead	46.00	
Magnesium	1800.00	J
Manganese	100.00	
Mercury	0.06	
Nickel	16.00	
Potassium	1200.00	J
Selenium	1.10	UJ
Silver	0.15	U
Sodium	96.00	UJ
Vanadium	26.00	J
Zinc	920.00	J

ERL = Effects range-low
ERM = Effects range-medium
TEL = Threshold effect level
PEL = Probable effect level
LEL = Lowest effect level
SEL = Severe effect level
[a] HQ for LEL is >1, and measured sediment concentration had a J flag (estimated value)

HQ > 1

Hazard quotients for aquatic life based on sediment exposures

Area: West-Background Tributary to West of Site

	Hazard Quotients							
	Ingersoll et al. (1996)				Environment Canada (1995)		Ontario (1993)	
Chemical	**ERL (ug/g-dry)**	**ERM (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**LEL (ug/g-dry)**	**SEL (ug/g-dry)**
Metals								
Aluminum	--	0.05	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--
Arsenic	0.42	0.11	0.49	0.11	0.92	0.32	0.90	0.16
Barium	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--
Cadmium	0.69	0.12	0.83	0.15	0.81	0.14	0.80	0.05
Calcium	--	--	--	--	--	--	--	--
Chromium	0.19	0.03	0.20	0.06	0.20	0.08	0.28	0.07
Cobalt	--	--	--	--	--	--	--	--
Copper	0.23	0.05	0.34	0.10	0.27	0.05	0.60	0.09
Iron	0.06	0.04	0.06	0.04	--	--	0.6	0.28
Lead	0.51	0.28	0.76	0.34	0.80	0.31	0.90	0.11
Magnesium	--	--	--	--	--	--	--	--
Manganese	0.66	0.28	0.76	0.40	--	--	1.04	0.44
Mercury	--	--	--	--	0.05	0.02	0.05	0.00
Nickel	0.27	0.14	0.33	0.20	0.36	0.18	0.41	0.09
Potassium	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	2.82	0.56	3.16	0.57	2.52	0.98	2.58	0.38

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[a] HQ for LEL is >1, and measured sediment concentration had a J flag (estimated value)
HQ > 1

Maximum Sediment Concentration

Chemical	**Max (ug/g-dry)**	**Flag**
Metals		
Aluminum	2800.00	
Antimony	0.58	
Arsenic	5.40	
Barium	65.00	
Beryllium	0.45	
Cadmium	0.48	
Calcium	18000.00	
Chromium	7.30	
Cobalt	3.50	
Copper	9.60	
Iron	11000.00	
Lead	28.00	
Magnesium	2100.00	
Manganese	480.00	
Mercury	0.01	
Nickel	6.50	
Potassium	320.00	
Selenium	0.64	
Silver	0.10	
Sodium	150.00	
Vanadium	11.00	
Zinc	310.00	

Hazard quotients for aquatic life based on sediment exposures

Area: *West Offsite Nearfield*

Chemical	Hazard Quotients							
	Ingersoll et al. (1996)				Environment Canada (1995)		Ontario (1993)	
	ERL (ug/g-dry)	ERM (ug/g-dry)	TEL (ug/g-dry)	PEL (ug/g-dry)	TEL (ug/g-dry)	PEL (ug/g-dry)	LEL (ug/g-dry)	SEL (ug/g-dry)
Metals								
Aluminum	--	0.33	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--
Arsenic	1.92	0.50	2.27	0.52	4.24	1.47	4.17[a]	0.76
Barium	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--
Cadmium	137.14	24.62	165.52	30.00	161.07	27.20	160.00	9.60
Calcium	--	--	--	--	--	--	--	--
Chromium	0.67	0.10	0.72	0.22	0.70	0.29	1.00	0.24
Cobalt	--	--	--	--	--	--	--	--
Copper	7.80	1.68	11.43	3.20	8.96	1.62	20.00	2.91
Iron	0.23	0.16	0.24	0.18	--	--	2.25	1.13
Lead	49.09	27.27	72.97	32.93	77.14	29.57	87.10	10.80
Magnesium	--	--	--	--	--	--	--	--
Manganese	0.52	0.22	0.60	0.32	--	--	0.83	0.35
Mercury	--	--	--	--	8.05	2.88	7.00	0.70
Nickel	1.13	0.27	0.60	0.36	0.67	0.33	0.75	0.16
Potassium	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	209.09	41.82	234.69	42.59	186.99	73.02	191.7[a]	28.05

ERL = Effects range-low
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TEL = Threshold effect level
PEL = Probable effect level
LEL = Lowest effect level
SEL = Severe effect level
[a] HQ for LEL is >1, and measured sediment concentration had a J flag (estimated value)
HQ > 1

Maximum Sediment Concentration

Chemical	Max (ug/g-dry)	Flag
Metals		
Aluminum	19000.00	
Antimony	12.00	
Arsenic	25.00	J
Barium	190.00	J
Beryllium	1.10	J
Cadmium	96.00	
Calcium	3600.00	
Chromium	26.00	J
Cobalt	14.00	
Copper	320.00	
Iron	45000.00	
Lead	2700.00	
Magnesium	2300.00	J
Manganese	380.00	
Mercury	1.40	
Nickel	27.00	
Potassium	1400.00	J
Selenium	1.40	J
Silver	2.40	
Sodium	89.00	UJA
Vanadium	30.00	J
Zinc	23000.00	J

Hazard quotients for aquatic life based on sediment exposures

Area: West-Offsite Middle Fork Shoal Creek Tributary

	Hazard Quotients							
	Ingersoll et al. (1996)				Environment Canada (1995)		Ontario (1993)	
Chemical	**ERL (ug/g-dry)**	**ERM (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**TEL (ug/g-dry)**	**PEL (ug/g-dry)**	**LEL (ug/g-dry)**	**SEL (ug/g-dry)**
Metals								
Aluminum	--	0.13	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--
Arsenic	0.30	0.08	0.35	0.08	0.66	0.23	0.65	0.12
Barium	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--
Cadmium	2.29	0.41	2.76	0.50	2.68	0.45	2.67	0.16
Calcium	--	--	--	--	--	--	--	--
Chromium	0.23	0.03	0.25	0.07	0.24	0.10	0.34	0.08
Cobalt	--	--	--	--	--	--	--	--
Copper	0.66	0.14	0.96	0.27	0.76	0.14	1.69	0.25
Iron	0.05	0.04	0.05	0.04	--	--	0.5	0.25
Lead	0.89	0.49	1.32	0.60	1.40	0.54	1.58	0.20
Magnesium	--	--	--	--	--	--	--	--
Manganese	0.58	0.25	0.67	0.35	--	--	0.91	0.38
Mercury	--	--	--	--	0.37	0.13	0.33	0.03
Nickel	0.37	0.20	0.45	0.27	0.49	0.25	0.56	0.12
Potassium	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	12.73[a]	2.55[a]	14.29[a]	2.59[a]	11.38[a]	4.44[a]	11.67[a]	1.71[a]

ERL = Effects range-low
ERM = Effects range-medium
TEL = Threshold effect level
PEL = Probable effect level
LEL = Lowest effect level
SEL = Severe effect level
[a] HQ for LEL is >1, and measured sediment concentration had a J flag (estimated value)
HQ > 1

Maximum Sediment Concentration

Chemical	**Max (ug/g-dry)**	**Flag**
Metals		
Aluminum	7700.00	
Antimony	0.83	
Arsenic	3.90	J
Barium	53.00	J
Beryllium	0.43	J
Cadmium	1.60	
Calcium	14000.00	
Chromium	8.90	J
Cobalt	4.00	
Copper	27.00	
Iron	9800.00	
Lead	49.00	
Magnesium	2700.00	J
Manganese	420.00	
Mercury	0.07	
Nickel	8.90	A
Potassium	570.00	J
Selenium	0.67	UJ
Silver	0.10	U
Sodium	88.00	UJ
Vanadium	12.00	J
Zinc	1400.00	J